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Rural-Urban Growth Linkages in India

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Improving the nonfarm response to growing demand from agriculture calls for appropriate growth in agricultural technology, adequate investments in rural infrastructure, and the avoidance of policies that discriminate against small, labor-intensive businesses in favor of their larger, capital-intensive cousins.

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This paper, a background paper for the FY1991 Country Economic Memorandum for India, is a product of the Agricultural Policies Division, Agriculture and Rural Development Department and is part of a larger effort in PRE to learn more about the indirect effects of agricultural growth on the rural nonfarm economy, and how the value of the income and employment benefits can be enhanced for the poor. Copies are available free from the World Bank, 1818 H Street NW, Washington DC 20433. Please contact Cicely Spooner, room N8-039, extension 30464 (79 pages with tables).

Using two models — an econometric analysis of cross-sectional data on states and districts and a semi-input-output model fitted to a national input-output table for 1979/80 — Hazell and Haggblade analyze the relationship between agricultural growth and growth in the rural nonfarm economy. They conclude that:

Because of strong links to agricultural growth, rural nonfarm income and employment will both grow faster than their agricultural counterparts. A sustained agricultural growth rate of 2.4 percent (the past trend) will lead to 3.0 percent growth in nonfarm income in rural areas and towns and 2.8 percent growth in nonfarm employment. If agriculture grows 4 percent, these rates increase to 5.8 percent and 4.0 percent, respectively.

Continued growth in agricultural output is unlikely to provide the growth in productive employment required to absorb projected increases in the rural labor force. The employment gap will increase if irrigation plays a decreasing role in agricultural growth. Secondary rounds of growth in the rural nonfarm economy could bridge this gap given moderate agricultural growth.

Export and domestic urban demand must play an important role if manufacturing is to continue to grow 8 percent a year. Despite the strength of the rural-urban linkages, agricultural growth alone cannot provide enough market to sustain rapid growth in India's manufacturing sector. An agricultural growth rate of 2.4 percent a year will generate only 1.8 percent (if irrigated agriculture) to 1.9 percent (if rainfed agriculture) growth in national manufacturing output. Even 6 percent growth in agriculture will generate only about 5.5 percent growth in manufacturing output.

Agricultural growth will lead to expansion in high-value agricultural output, especially livestock and horticultural products. Increased production of these labor-intensive products should especially benefit the poor.

The size of the agricultural income multipliers depends primarily on the level of per capita agricultural income, but public policy can affect their magnitude. They are positively related to the development of such rural infrastructure as roads, electrification, and banking services. They are stronger under irrigated than rainfed agricultural growth and larger for small- to medium-size farms than for larger farms.

Improving the nonfarm response to growing demand from agriculture calls for appropriate growth in agricultural technology, adequate investments in rural infrastructure, well-developed rural towns, and the avoidance of tax, regulatory, or licensing policies that discriminate against small, labor-intensive businesses in favor of their larger, capital-intensive cousins.

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RURAL-URBAN GROWTH LINKAGES IN INDIA

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The authors are grateful to Ataman Aksoy, Pamela Cox, Keith Oblitas, Frank Place, Teja Rapariu, and Roger Slade for helpful comments on earlier drafts.

EXECUTIVE SUMMARY

i. The rural nonfarm economy accounts for 20 percent of full-time employment in India's rural economy and for 30 percent of rural income. Expanding the definition of rural to include rural towns up to 100,000 in size, these shares increase to 25 percent and 35 percent, respectively. Nonfarm activities are especially important to the poor; landless laborers and small farmers typically obtain half or more of their income from nonagricultural activities. Women are also active participants, particularly in food processing and household manufacturing activities. Seen in this context, it is clear that the rural nonfarm economy will play a key role in determining future prospects for employment growth and poverty alleviation in India.

ii. Dominating the rural nonfarm economy are commerce, service and small-scale manufacturing activities that cater largely to agricultural and rural consumer demands. As such, their fate is intimately linked to agricultural performance. This can be seen in the shifting structural composition of the Indian economy over time. The nonfarm shares of national employment and income remained almost constant for many decades, but showed a sizeable increase in the 1970s. This change coincided with a period of rapid agricultural growth associated with the green revolution.

iii. The relationship can also be seen by comparing states of varying agricultural performance. High performance states, such as Punjab and Haryana, have a greater density of rural nonfarm activity, a greater density of rural towns, and proportionally more commerce, service and factory manufacturing than states with poorer records of agricultural productivity and growth.

iv. More formally, the relationship between agricultural growth and growth in the rural nonfarm economy can be analyzed with the aid of models. Two approaches are used in this paper. The first is an econometric analysis of cross-sectional state- and district-level data. The second is based on a semi-input- output model fitted to a

national input-output table for 1979/80. Both approaches provide estimates of the agricultural income multiplier, defined as the increase in value added in the nonfarm sector attributable to a one rupee increase in agricultural value added.

v. The econometric analysis leads to an estimated income multiplier of Rs 0.64, distributed as Rs 0.39 in the rural towns and Rs 0.25 in rural areas. The multiplier is largest in high-income agricultural regions; Rs 0.93 in Punjab and Haryana versus Rs 0.46 in low productivity agricultural states such as Madhya Pradesh and Bihar.

vi. In contrast, the semi-input-output model leads to an agricultural income multiplier of Rs 1.35. This is twice as large as the econometric estimate because the semi-input-output multiplier pertains to the national, not just the rural, economy and assumes highly elastic supplies of nonagricultural outputs. The semi-input-output model also provides disaggregated multipliers for different types of agricultural growth. The income multiplier for irrigated agriculture is Rs 1.56 but it is only Rs 1.23 for rainfed agriculture.

vii. The models are used to project, through the year 2040, the volume of nonfarm income, employment and rural demand for manufactured goods that will result from agricultural growth. They project nonfarm increases under a range of agricultural growth rates and separately for irrigated versus rainfed expansion. The following conclusions emerge:

- Because of strong agricultural growth linkages, rural nonfarm income and employment will both grow faster than their agricultural counterparts. A sustained agricultural growth rate of 2.4 percent (equal to past trend) will lead to 3.0 percent growth in nonfarm income in rural areas plus rural towns, and 2.8 percent growth in nonfarm employment. These growth rates increase to 5.8 percent and 4.0 percent, respectively, if agriculture grows at the Planning Commission's target of 4 percent.

- By itself, continued trend growth in agricultural output is unlikely to provide the growth in productive employment that is required to absorb projected increases in the rural labor force. The employment gap will increase further if irrigation plays a reduced role in future agricultural growth. However, secondary rounds of growth induced in the rural nonfarm economy will bridge this employment gap given moderate rates of agricultural growth. This will be especially important to the rural poor who depend on nonfarm activity for sizeable shares of their total incomes. Consequently, the rural nonfarm economy merits close attention in India's rural development strategy.

- Despite the strength of the rural-urban linkages, agricultural growth alone cannot provide the necessary market to sustain rapid growth in India's manufacturing sector. An agricultural growth rate of 2.4 percent per year will generate 1.8 to 1.9 percent growth in national manufacturing output; the higher figure relates to irrigated agriculture, the lower figure to rainfed agriculture. Even a six percent agricultural growth rate will sustain only about 5.5 percent growth in manufacturing output. Clearly, export and domestic urban demand will have to play an important role if manufacturing is to continue to grow at eight percent or more per annum.

- Agricultural growth will lead to strong expansion in high-value agricultural output, especially livestock and horticultural products. For example, an agricultural growth rate of 2.4 percent will generate nearly four percent growth in the output of these products. Given their high labor intensity, increases in the production of these products should be especially beneficial to the poor.

viii. Although the size of the agricultural income multipliers depend primarily on the level of per capita agricultural income, public policy can influence their magnitude. The multipliers are positively related to the development of rural infrastructure (roads, electrification, banking services, etc.). They are stronger under irrigated rather than rainfed agricultural growth and larger for small- to medium-sized farms than for very large farms. Hence appropriate regional and farm targeting of agricultural technology, supported by adequate infrastructural investments, will be especially important for improving the nonfarm response to growing demand from agriculture. Moreover, other studies have shown that well-developed rural towns foster stronger rural-urban growth linkages, and that government policies towards small nonfarm businesses are important. It is particularly important to avoid tax, regulatory or licencing policies that discriminate against small, labor-intensive businesses in favor of their larger, capital intensive cousins. These relationships provide a rich agenda for identifying government policies that will strengthen the size and distribution of the indirect benefits emanating from agricultural growth.

RURAL-URBAN GROWTH LINKAGES IN INDIA

I. INTRODUCTION

1. The rural nonfarm economy accounts for one-quarter of all full-time employment in rural India and for nearly one-third of rural income. It is also the backbone of the economy of numerous small towns scattered throughout the countryside as well as the primary source of income and employment for many of India's poor. Seen in this light, the rural nonfarm economy will play a key role in determining future prospects for employment growth and poverty alleviation in India.

2. The rural nonfarm economy is also intimately linked to agriculture. For example, a substantial share of rural manufacturing involves agroprocessing and the production, repair and supply of farm inputs. Moreover, the dominant sectors in the rural nonfarm economy consist of trade and service establishments that cater largely to rural consumer demand. The prospects for growth in the rural nonfarm economy will, therefore, hinge on future agricultural performance.

3. Increases in farm income stimulate demand for consumer goods and services (Mellor 1976). Likewise, a growing agriculture demands production inputs and supplies raw materials to transport, processing and marketing firms. In addition to stimulating national economic growth, these production and consumption linkages affect poverty and spatial growth patterns. Because most of the resultant growth in nonfarm activity is located in rural areas and small towns, it can contribute to the containment of excessive rural-to-urban migration. Moreover, when agricultural growth is focused on small and medium-sized farms, the resulting demand patterns typically favor products produced by small, labor-intensive enterprises whose growth can contribute to increased employment opportunities for the poor (Johnston and Kilby 1975).

4. This paper examines the importance of these rural-urban growth linkages in India. It aims to assess the impact of agricultural growth on national demand for nonfarm products. In addition, because growing land scarcity raises concerns about prospects for rural labor absorption, the paper highlights the impact of agricultural growth on rural nonfarm incomes and employment.

5. Four major sections address these objectives. The first provides a descriptive overview of nonfarm activity in India. It examines the importance, composition and location of nonfarm activity as well as general trends over the past 30 years. The second explores the relationship between agriculture and changes in nonfarm activity. After reviewing previous growth linkage studies, it compares nonfarm activity in high- and low-productivity agricultural states cross-sectionally and over time. The third section estimates the volume of rural nonfarm income and employment generated by agricultural growth, while the fourth projects patterns of demand for nonfarm goods emanating from alternative agricultural growth scenarios.

II. DESCRIPTIVE PROFILE OF NONFARM ACTIVITY

A. Importance

6. Nonfarm enterprises account for one-third of all full-time employment in India (Table 1). In large cities, nonagricultural pursuits occupy 95 percent of the workforce, in rural towns, 75 percent, and in rural areas, 20 percent. These proportions have remained roughly constant since 1961.

7. Part-time and seasonal employment frequently increase the importance of nonfarm activity. Indeed, some nonfarm undertakings in India are highly seasonal; 20-50 percent of rural manufacturing enterprises operate only part-time or seasonally (National Sample Survey, 1969). But in the aggregate, measured secondary employment appears very small. According to the 1981 population census, only 2.4 percent of

India's economically active population finds secondary employment in nonfarm sectors.[1] This holds true in both rural and urban areas. National Sample Survey data place the rural figure even lower (National Sample Survey 1961). Of course, standard labor force definitions, because of their emphasis on usual employment and inability to fully capture female participation, may obscure the extent of seasonality and part-time nonfarm employment, as the following income figures suggest.

8. Income data reveal a larger role for nonfarm activity, indicating that it contributes about two-thirds of national income compared to a one-third employment share. Similarly in rural areas, excluding rural towns, nonagriculture normally contributes 25-35 percent of total income in contrast with its 20-25 percent share of employment (Table 2). The higher income than employment share implies either greater returns to labor in nonfarm activity or considerable part-time and seasonal nonfarm pursuits uncaptured in the employment statistics.

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[1] See India (1988), Table 8-6.

Table 1: Nonfarm Share of Total Employment: India 1961/81

Year	Rural Areas Plus Rural Towns			Large Urban [b/]	Total National
	Rural Areas	Rural Towns [a/]	Total RRT		
	(Percent of Total Full-Time Workers)				
1961	18.0	79.4	22.8	96.2	27.7
1971	15.2	76.5	20.4	95.4	27.9
1981	18.9	77.4	24.3	95.8	33.3

a/ Rural towns are defined as urban areas under 100,000 in population. They are settlements of between 5,000 and 100,000 people.

b/ Large urban settlements are all those with population exceeding 100,000. Total urban figures reported in the censuses equal the sum of what have been partitioned here into rural towns and large urban settlements.

Source: Population census of 1961, 1971, and 1981. See India (1961a-d, 17a-b and 1981b). Raw data are reproduced in Appendix Table A.1.

Table 2: Nonfarm Share of Rural and Urban Income [a/]: India 1967/68 to 1981/82

Source of Income	RURAL						Urban
	1967/68	1968/69	1969/70	1970/71	1975/76	1981/82	1975/76
Agriculture							
Own farm	62.8	54.9	61.2	60.5	55.8	53.3	4.7
Wage labor[b/]	(11.7)	19.9	17.7	17.4	13.7	(16.5-11.9)	0.5
Total agriculture	(74.5)	74.8	78.9	77.9	69.5	(69.8-65.2)	(5.2)
Nonfarm							
Self-employment	10.3	8.4	7.6	9.0	8.1	-	26.4
Wage labor[b/]	(2.0)	3.4	2.1	3.0	8.6	(2.9 - 7.5)	10.6
Salary	10.5	8.0	5.9	5.8	9.8	-	49.1
Rent & dividends	2.7	5.4	5.5	4.3	4.0	-	5.6
Total nonfarm	(25.5)	25.2	21.1	22.1	30.5	(30.2 - 34.8)	--
Total Income	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

a/ Excludes transfer income from 1967/68 and 1975/76 to make income definition comparable with other years.

b/ In some years, published results fail to disaggregate farm and nonfarm wages. Figures in parentheses partition wages based on farm and nonfarm shares prevailing in other years. For 1967/68, the estimated wages breakdown takes nonfarm share of total wages at 15 percent, the level prevailing in 1968/69-1970/71. Since nonfarm share of wages appear to have risen over time, the 1981/82 estimate offers a range. The lower bound takes nonfarm wage share at 15 percent, the upper bound puts it at 38.7 percent, the level prevailing in 1975/6.

-- Not applicable. Wages disaggregated in those years.

- Breakdown not available

Source: National Council for Applied Economic Research (1972, 1975, 1980, 1986a).

9. Although many labor-intensive nonfarm activities provide work opportunities for the very poor, the aggregate data suggest a mixed impact on income distribution. In rural and urban areas alike, nonfarm income constitutes the largest share of income among both the very poor and the very rich (Table 3). For the wealthy, salaries, business profits and rents are most important, while the poor depend most heavily on wage income, both farm and nonfarm.[2]

10. By landholding, no such ambiguity arises. The smallest landholders routinely depend more heavily on nonfarm earnings than do families with larger holdings (Tables A.2 and A.3). Moreover, the recent NCAER panel study of rural households indicates that over time the smallest rural landholders, like all rural households, have become increasingly dependent on nonfarm earnings (Table A.3).

B. Location

11. Not surprisingly, the density of nonfarm activity increases dramatically in urban areas and with town size. In rural settlements, about 50 people per thousand work in nonfarm occupations (Table 4). Yet in even the smallest rural towns, of 10,000 to 20,000, that figure quadruples. A second jump in nonfarm activity occurs as town size increases to 50,000 and then 100,000.

12. Currently, about 20 percent of India's nonfarm employment is based in rural towns, defined in this paper as localities between 5,000 and 100,000 in population.[3] A further 35 percent reside in large cities over 100,000, while rural areas house the remaining 45 percent (Table A.4).

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[2] Unfortunately, as in Tables 2 and 3, most studies fail to disaggregate between farm and nonfarm wages when presenting income distribution profiles. But aggregate income figures indicate that nonfarm wages account for about 40 percent of rural wages and 95 percent of urban wages. Applying these percentages to the wage data in Table 3 indicates that under any conceivable farm-nonfarm distribution, nonfarm wages account for a far higher share of income for the poor than for the rich. Pal and Quizon (1983, Table 13) corroborate this with NCAER data from 1970/71.

[3] The remaining urban settlements, those over 100,000 are referred to as large cities.

Table 3: Income Distribution by Functional Classification, India 1975/76

Income Level	Farming	Wages [a/]	Salary	Business	Rent, Dividends, Transfers	Total
(Rs/Household)			(Percent)			
Rural Areas						
Less than 3,600	40.1	45.0	2.3	6.0	6.3	100
3,601- 7,500	58.5	16.2	11.7	7.0	6.6	100
7,501-15,000	64.5	2.1	18.8	8.4	6.2	100
15,001-30,000	74.5	.2	10.0	9.8	5.5	100
Over 30,000	40.5	0	7.5	38.8	13.2	100
Urban Areas						
Less than 3,600	4.7	54.6	16.4	17.3	7.0	100
3,601- 7,500	5.0	15.6	50.5	21.1	7.8	100
7,501-15,000	4.7	2.1	56.5	26.9	9.8	100
15,001-30,000	3.8	.1	57.5	29.4	9.0	100
Over 30,000	6.4	0	41.0	44.1	8.5	100

a/ Includes farm and nonfarm wages together. Nonfarm wages account for roughly 40 percent of rural wages and 95 percent of urban wages.

Source: NCAER, 1980.

Table 4: Nonfarm Employment Density by Size of Settlement India, 1971

Size of Locality	Nonfarm Employment	Agricultural Employment
	(Employment per 1,000 Population)	
Urban		
100,000 plus	284	14
50,000–99,999	243	39
20,000–49,000	224	61
10,000–19,999	199	93
5,000– 9,999	198	96
Rural		
Under 5,000	51	287

Source: India (1971a-b)

C. Composition

13. The composition of nonfarm activity differs considerably across locality sizes. In rural areas, services and household manufacturing dominate nonagricultural pursuits (Table 5). But in the move to rural towns, commerce and services lead the dramatic surge in nonfarm activity. Similarly, factory manufacturing and transport increase substantially. Even the prevalence of household manufacturing increases in rural towns, although it declines in importance in large urban centers. In the largest urban localities, factory manufacturing emerges as the dominant nonfarm activity.[4]

[4] The data in Table 5 come from 1971 because the 1981 breakdown of rural towns is not yet available.

Table 5: Composition of Nonfarm Activity by Size of Locality · India 1971

		Non-Agriculture								
	Agriculture	Total	Mining	House-Hold Mftr.	Non-House-Hold Mftr.	Constr.	Comm.	Trans.	Other Services	TOTAL
	(Full-Time Employment per 1,000 Population)									
Total Employment										
Rural	287	51	1	11	8	2	8	3	18	338
Rural Town a/	68	220	4	19	43	10	56	23	65	287
Large Urban b/	14	284	2	11	86	10	61	34	79	298
Males										
Rural	230	45	1	9	7	2	8	3	16	274
Rural Town	54	198	4	15	39	9	54	22	55	252
Large Urban	12	260	2	9	82	10	58	33	66	271
Females										
Rural	57	7	0	2	1	0	1	0	2	64
Rural Town	14	22	0	4	3	1	2	1	10	36
Large Urban	2	25	0	2	4	1	3	1	13	27

a/ Rural towns are all urban areas under 100,000 in population.
b/ Large urban areas are all above 100,000 in population.

Source: India (1971a-b)

14. These differences, at least as measured by employment statistics, reflect almost exclusively changes in the level and composition of male employment. Measured female participation[5] remains minor in all locality sizes and activities and increases perceptibly only in services in rural towns.

D. Female Participation

15. Females account for about 15 percent of national employment, 20 percent in agriculture and 10 percent in nonfarm activity (Table 6). Among nonfarm occupations, women are most prevalent in household industries, where they account for 20 percent of all workers. Since household manufacturing declines precipitously in large cities, the female share of nonfarm and total employment drops to its lowest level in these major centers.

16. Employment data, though they afford the most comprehensive framework for viewing changes in nonfarm activity and differences across regions, are least reliable in evaluating women's economic role. The invisibility of women working in the home coupled with a restricted definition of economically gainful activity compromise our efforts to fully measure the economic participation of women. Table 7 illustrates the potential magnitude of the undercounting, what some refer to as the 'statistical purdah' (World Bank, 1989). Beginning in 1971, the population census adopted a more restrictive employment definition than that used in 1961,[6] and nonfarm activities in which women predominate bore the brunt of the discounting. Measured female nonfarm and total participation rates dropped by over 60 percent between the two

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[5] See World Bank (1989) for a good discussion of how dramatically conventional labor force definitions undercount female participation.

[6] Natarajan (1982) and Jacob (1986) provide a good review of the problems with changing labor force definitions. Table A.4 illustrates some of the anomalies resulting from the changing definition. Notice the measured decline in total and nonfarm workers between 1961 and 1971 even in the face of a 20 percent increase in population.

Table 6: Women's Share in Total Employment, India 1971

Activity	Rural Areas	Rural Towns a/	Large Urban b/	Total National
		(percent)		
Agriculture	19.9	20.6	14.3	19.8
Nonfarm				
Mining	15.2	10.4	10.0	13.4
Household industry	21.0	22.7	18.5	21.0
Nonhousehold manufacturing	12.8	7.8	5.1	8.1
Construction	9.8	7.9	9.1	9.2
Commerce	7.8	4.3	4.3	5.5
Transport	3.2	3.4	3.4	3.3
Other services	12.3	15.1	16.5	14.1
Total nonfarm	12.9	9.9	8.6	10.8
Total full-time Workers	18.8	12.4	8.9	17.4

a/ Rural towns are all urban areas under 100,000 in population.

b/ Large urban areas are all settlements above 100,000 in population.

Source: India (1971a-b).

Table 7: Trends in Measured Female Participation Rates, India 1961–81

	Female Workers per 1,000 Population	Female Nonfarm Workers per 1,000 Population	Female Workers as a percent of all Fulltime Workers
Rural			
1961	154	22	34.2%
1971	64	7	18.9%
1981	78	9	22.5%
Total National			
1961	135	25	31.4%
1971	57	10	17.3%
1981	68	13	20.2%

Source: India (1961a-d), 1971a-b, 1981c). See Appendix Table A.5 for a detailed disaggregation.

our understanding of poverty given the low-return, part-time, labor-intensive, often home-based activities in which women predominate.

E. Trends

17. The years since 1961 have witnessed several changes in the Indian nonfarm economy. As Table 1 indicates, the decade of the 1970s represents a key turning point. Up until 1970, India's agricultural share of national employment remained constant, constant for a century or more according to some.[7] Not until the 1981 census did the first evidence emerge of an increase in the national share of nonfarm employment; it rose from 28 percent in 1971 to 33 percent in 1981. The income profiles tracked by NCAER researchers likewise identify the first substantial boost in rural nonfarm incomes during the 1970s (Table 2). This coincides with the widespread

[7] See Sinha (1982), Vyas and Mathai (1978) and Deshpande and Deshpande (1985).

employment; it rose from 28 percent in 1971 to 33 percent in 1981. The income profiles tracked by NCAER researchers likewise identify the first substantial boost in rural nonfarm incomes during the 1970s (Table 2). This coincides with the widespread adoption of green revolution wheat and rice varieties and provides at least circumstantial evidence linking the big spurt in agricultural growth with enlargement of the nonfarm economy.

18. Urbanization has accompanied the rising prominence of nonfarm activity. The nonfarm employment densities have remained constant in rural areas, rural towns and in large urban centers (Table 1). This, coupled with the rising national share of nonfarm in total employment, can only be possible if rural towns and large cities increase in relative size, as indeed they have.

19. Yet nationally, the composition of nonfarm activity has shifted only slightly during its decade of growth. Because of changing labor force definitions, reported differences between 1961 and later years do not reliably track changes in economic activity. Between 1971 and 1981, when definitions remained roughly comparable, the only perceptible change has been a slight increase in the prominence of nonhousehold manufacturing in both rural and urban areas (Table 8). Disaggregation at the state level, however, does reveal a more substantial shift, as Section III. C. will discuss.

Table 8: Changing Composition of Nonfarm Activity, India, 1961 to 1981

		Non-Agriculture								
	Agriculture	Total	Mining	House-Hold Mfg.	Non-House-Hold Mfg.	Constr.	Comm.	Trans.	Other Services	TOTAL
	(Full-Time Employment per 1,000 Population)									
Rural Employment										
1981	290	57	1	11	12	4	10	4	17	346
1971	287	51	1	11	8	2	8	3	18	338
1961 a/	369	81	-	28	7	3	9	2	32	450
Urban Employment										
1981	38	253	2	14	72	12	58	27	68	289
1971	37	256	3	15	67	10	59	29	73	293
1961 a/	42	293	-	26	70	12	55	27	102	335

a/ Labor force definition in 1961 not comparable with those in 1971 and 1981.

Source: India (1961a-d, 1971a-b, 1981c).

III. AGRICULTURE AND GROWTH OF THE NONFARM ECONOMY

A. Key Linkages

20. Why does nonfarm activity vary over time and across regions? Certainly resource endowments, location, ethnicity, historical happenstance, and government policy all play a role. Yet agriculture, because of its size, must be added to the list of key suspects.

21. Agriculture can influence nonfarm activity in at least three ways: through production, consumption and labor market linkages. On the production side, a growing agriculture requires inputs -- of fertilizer, seeds, herbicides, pumps, sprayers, equipment and repair services -- either produced or distributed by nonfarm enterprises. Moreover, increased agricultural output stimulates forward production linkages by providing raw materials that require milling, processing and distribution by nonfarm firms. Consumption linkages arise when growing farmer incomes boost demand for basic consumer goods; these typically increase over time as rising per capita income induces diversification of consumption spending into nonfoods. Much of the overall increase in demand -- for inputs, services, distribution and many basic consumer goods -- can be serviced by firms in rural areas, and rural towns. Yet the heavy production inputs and consumer durables are more likely to be produced in large cities or abroad.

22. Although production and consumption linkages have attracted most of the initial interest in agricultural growth linkages (Mellor and Lele, 1972; Johnston and Kilby, 1975), more recent investigations highlight a third important link, the labor market interactions. In rural areas, in particular, rising agricultural wages raise the opportunity cost of labor in nonfarm activities. This induces a shift in the composition of nonfarm activity out of very labor-intensive, low-return activities and into more skilled, higher investment, high-return activities (Hossain, 1988; Ahmed and Hossain,

1988). Thus rising agricultural productivity may be instrumental in inducing a structural transformation of the rural nonfarm economy.

B. Prior Evidence

23. Not all analysts have expressed confidence in the prospects for agricultural-led growth. In a provocative and often-cited review, Vyas and Mathai (1978) argue that agricultural growth has not in fact stimulated development of the rural nonfarm economy. Using the population census data reproduced in Table 1, they point out that the nonfarm share of rural and urban employment remained unchanged between 1961 and 1971. In their view, skewed income gains in agriculture limited consumption linkages, while inadequate rural infrastructure limited the ability of rural firms to supply the modest increases in input and consumer demands.

24. Yet most subsequent analyses -- based on longer time series or disaggregated at the state of district level -- dispute Vyas and Mathai's pessimistic conclusion.[8] Time series evidence from fast-growing agricultural states document the strongest connections between agriculture and the nonfarm economy (Chadha, 1986a). Studies of the Punjab (Chadha, 1986b; Bhalla, et al. 1989) and Haryana (Bhalla, 1981) all highlight the importance of rising demand for consumer goods and agricultural inputs as the result of increased agricultural production. Chadha, in particular, emphasizes the importance of farm machinery and other input supply in the Punjab. He notes that while state manufacturing grew at the same rate as agriculture in the 1960s, it grew much faster than agriculture in the 1970s. Because of first-mover advantages, he believes, machinery manufacture established to supply its own state agriculture stood poised to export to other states in the 1970s. If so, these spillovers caution that identifying the spatial distribution of agricultural growth linkages may be complex.

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[8] The most direct rebuttal, based on longer time series, comes from Deshpande and Deshpande (1985).

25. These studies likewise corroborate Ahmed and Hossain's (1988) initial evidence on labor market linkages. In Haryana and the Punjab, increased demand for agricultural labor has resulted in the highest farm wages in India. By raising the opportunity cost of labor in nonfarm pursuits, this has led to a decline in very low-return household manufacturing and a parallel rise in higher-return modern small factories and services.

26. Other time-series evidence comes from the moderately prosperous agricultural region of North Arcot. Using a simulation model for the region, Hazell and Ramasamy (1989) have estimated demand multipliers emanating from agricultural growth over the 1970s. They estimate that as a result of production and consumption linkages every 100 Rs. increase in agricultural income induced an additional 82 Rs. in income in other sectors of the rural economy. Production linkages accounted for about half of the increase and consumption linkages the other half.

27. To date, cross-section comparisons across districts and states have produced similar, although less robust, correlations between agriculture and nonfarm activity. In part, this arises because so many important factors other than agriculture vary across areas, and they also influence the level of nonfarm activity. Raw material availability varies across regions; consequently leatherworking industries predominate in Rajastan, while wood processing is largest in well-forested states like Bihar (Papola, 1985). Moreover, tradition, caste, historical accident,[9] and India's elaborate system of subsidies and policy protection for small and village industries[10] complicate cross-section comparisons.

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[9] Papola (1985), for example, describes one district in Uttar Pradesh specializing in the production of plastic jewelry which it supplies to much of the rest of India. Despite an absence of local raw materials or market, the activity flourishes, for no obvious reason. He surmises that tradition or historical accident must explain this puzzle.

[10] See Singla et al. (1983) for evidence on the connection between government support and level of nonfarm activity.

28. Even so, Radhakrishna et al. (1988), who compared three advanced agricultural districts in Uttar Pradesh with three laggards, found a higher nonfarm employment share in the agriculturally prosperous areas. Papola (1985), comparing two different districts in the same state, found no correlation. But since he covered only a portion of rural nonfarm activity -- and the least buoyant at that, household manufacturing -- the lack of association cannot be considered persuasive.

29. Khandker (1988) has used pooled time series, cross-section district data to examine the relationships among rural employment, wages, agriculture and infrastructure. He finds both agricultural output and nonfarm employment higher in regions with higher agroclimatic potential, but he does not attempt to measure the direct connection between the two.

30. The labor market links between agricultural and rural nonfarm activity seem consistently robust in the cross-section studies. All comparisons to date have confirmed the positive relationship between earnings in agriculture and earnings in rural nonfarm activity.[11]

C. Comparisons Across States

31. To further explore the effect of agriculture on nonfarm activity, this section undertakes a descriptive analysis using state-level data. After ranking states according to agricultural productivity, it selects six for careful review, two high-, two low- and two medium-productivity states. Initially, cross-section comparisons examine how the size, composition and location of nonfarm activity vary across productivity zones. Then discussion turns to the time-series evidence from these same six states to see how growth in agriculture affects growth of the nonfarm economy.

32. Table 9 ranks states according to several measures of agricultural productivity. It shows that per capita agricultural income, per capita total income, per capita

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[11] See Papola (1985), Chadha (1986) and Radhakrishna et al (1988).

foodgrain production and growth rate of foodgrain production all provide a broadly similar ranking. So from this listing, two high-productivity states (Punjab and Haryana), two low-productivity states (Bihar and Madhya Pradesh) and two middle-productivity states (Karnataka and Gujarat) have been selected for review.

33. Consider first the density of nonfarm activity, which is generally higher in high-income agricultural states. As Table 10 indicates, this holds true in both rural and urban areas. But as the complete state profile in Figure 1 shows, the generally positive association between nonfarm activity and agricultural income masks considerable variation in individual states. Kerala in particular houses an unusually high proportion of rural nonfarm activity for reasons that appear unrelated to the character of the state's agriculture. Figure 1 further illustrates the stronger farm-nonfarm association when one expands the concept of rural to include rural towns.

34. Indeed it is important to separate out the rural towns. Our six-state comparison suggests a greater predominance of rural towns in the high-income agricultural states. In fact, rural towns in Punjab and Haryana house nearly twice the population share of similar-sized settlements in Bihar and Madhya Pradesh. (Table A.6).

35. Furthermore, the relationship seems to hold more generally across India. States with high farm income are typically more urbanized and less rural than states with low-productivity agriculture (Table 11). And the big difference in urban structure lies in the predominance of intermediate-sized towns. This suggests that a growing agricultural sector may indeed contribute to a dispersed pattern of urbanization, as Mohan (1984) and Wanmali (1988) maintain.

Table 9: Agricultural Productivity Ranking of Major Indian States

	Agricultural Income Per Agricultural Population			Total Income Per Capita	Foodgrain Production	Annual Rate of Growth in Food Production
	1982/83	Average 1983/84 1985/86	Average 1973/74- 1975/76	1982/83	Average 1984/85- 1986/87	1961/62- 1983/84
		(Rs./Capita)		(Rs/Capita)	(kg/capital	(percent)
Punjab [a/]	2,764	3,423	1,486	3,484	924	6.3
Haryana [a/]	2,357	2,773	1,263	2,798	507	4.6
Kerala	1,347	2,250	1,018	1,447	43	1.0
Rajasthan	1,314	1,651	739	1,574	191	2.5
Maharashtra	1,294	1,623	662	2,525	123	2.0
Andhra Pradesh	1,282	1,440	734	1,536	165	2.4
Karnataka [a/]	1,136	1,501	837	1,559	157	2.6
Gujarat [a/]	1,116	1,626	718	2,182	98	4.2
Orissa	1,066	1,256	634	1,308	219	1.5
West Bengal	920	1,813	699	1,595	156	1.4
Uttar Pradesh	902	1,106	503	1,439	247	3.0
Madhya Pradesh [a/]	862	1,189	570	1,311	239	1.6
Tamil Nadu	731	742	595	1,373	135	.6
Bihar [a/]	599	852	415	995	138	.7

a/ Selected for comparative analysis.

Source: Economic Intelligence Service (1988), Economic Monitoring Service (1986).

Table 10: Density of NonFarm Activity Across States with Differing Agricultural Incomes, India 1981

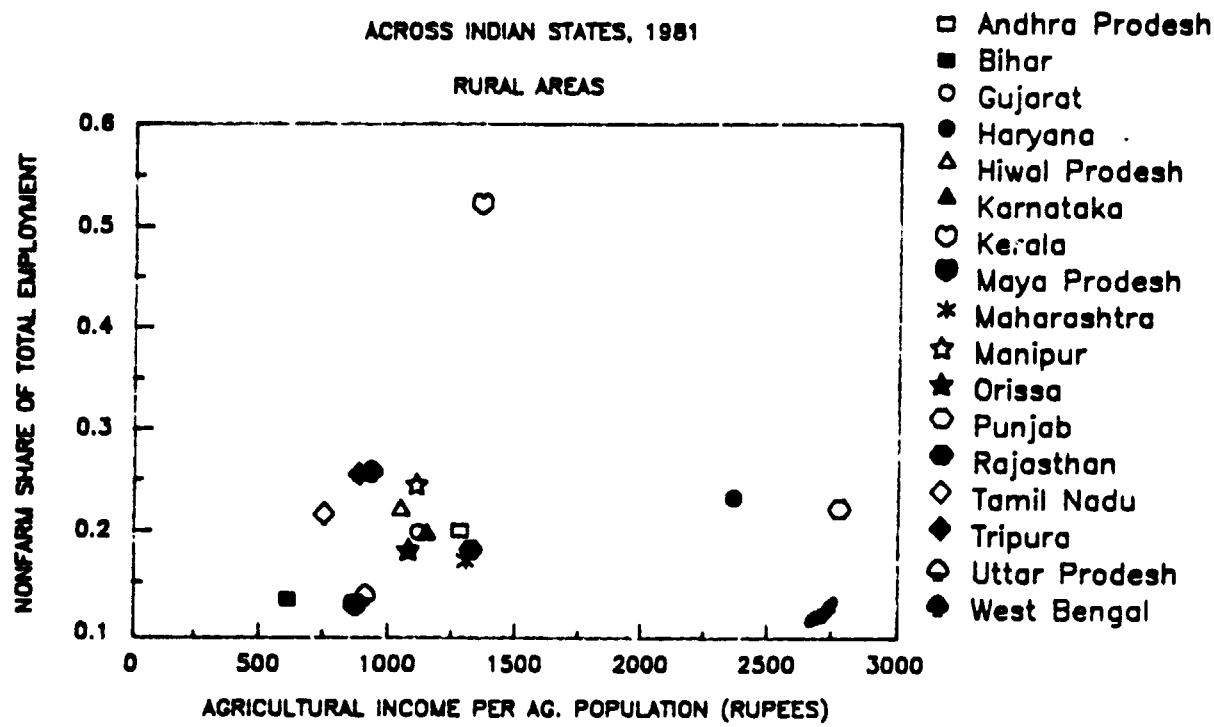
States	Rural Areas	Urban Areas [a/]
	(Full-time Workers per 1,000 Population)	
High Agricultural Income		
Punjab	67	263
Haryana	67	258
Medium Agricultural Income		
Karnataka	61	247
Gujarat	53	258
Low Agricultural Income		
Madhya Pradesh	44	241
Bihar	38	212

a/ Urban includes all localities over 5,000 in population. It encompasses both rural towns and large urban areas.

Source: India (1981c).

FIGURE 1

RELATIONSHIP BETWEEN NONFARM EMPLOYMENT AND AGRICULTURAL INCOME



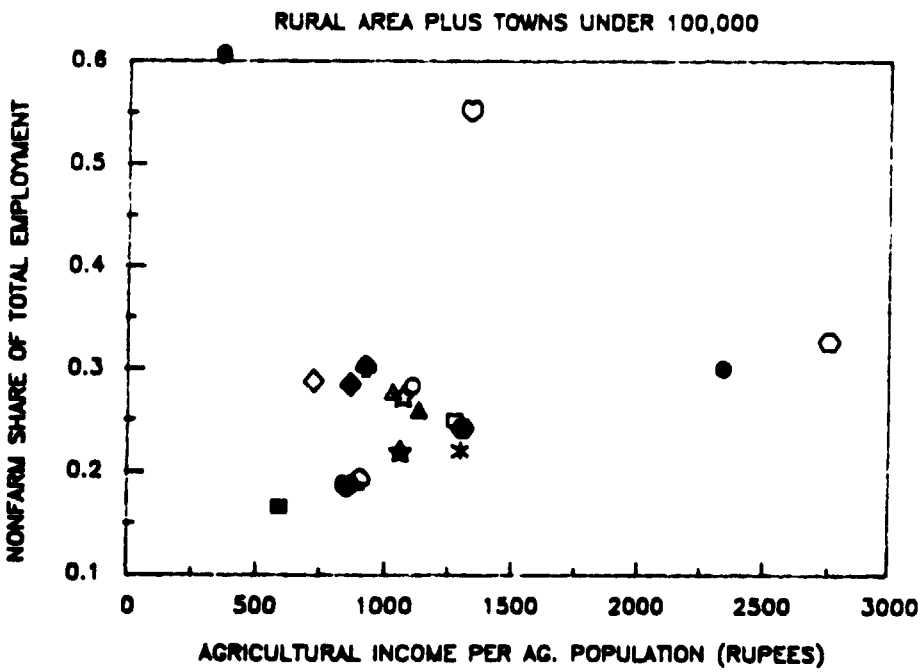


Table 11: Correlation Between Agricultural Productivity, Population and Location of Nonfarm Activity, Indian States, 1981

	Correlation Coefficient between Agricultural Income per Agricultural Population and Share in Each Locality Size of			
	Nonfarm Employment		Population	
	All States	All Except Kerala	All States	All Except Kerala
Rural Areas	-.23	-.28	-.23	-.24
Rural Towns				
5 - 100	.33	.38	.41	.41
5 - 250	.49	.57	.44	.45
Large Urban				
100 +	.08	.10	.08	.09
250 +	-.06	-.05	-.04	-.04

Source: Employment and population data from India (1981b).
Agricultural income data from Economic Intelligence Service (1988).

36. The composition of nonfarm activity also differs in high-income agricultural states. The prominence of services, commerce and factory manufacturing rises perceptibly there, while household manufacturing attains less importance (Table 12). These differences stand out most clearly in rural areas where the high-income states attract double the volume of services, commerce and factory manufacturing and only half the level of household manufacturing as in states with low-income agriculture. Consequently, the disparity between rural and the urban nonfarm employment profiles becomes most pronounced in the low-income states because of their lower level of rural nonfarm activity (Table A.7).

37. Over the growth decade of the 1970s, urban nonfarm employment has increased most rapidly in the high-productivity agricultural states (Table A.8). Yet rural nonfarm employment has grown at about the same rate in high- and low-income states, perhaps because the initial spurt in Punjab and Haryana began in the late 1960s, earlier than elsewhere. Unfortunately, the change in census employment definitions makes it impossible to confirm this, although Bhalla et al. (1989) advance anecdotal evidence of rapid growth in small agroindustries during the 1960s.

38. In rural areas across India, the most rapidly growing segment of the nonfarm economy has been factory manufacturing. (Table A.8). In high-income states, commerce and transport have also contributed. Likewise, in urban areas factory manufacturing has dominated increments to the nonfarm labor force.

39. Wage data reveal substantially higher farm earnings in Punjab and Haryana than in the other states. Although the gap has narrowed slightly in real terms, agricultural wages in Punjab and Haryana remain roughly double those in Bihar and Madhya Pradesh (Table A.10). Thus in part, the higher level of nonfarm activity in the high-productivity

Table 12: Composition of Nonfarm Activity Across States with Differing Agricultural Incomes
India 1981

	Total Nonfarm	Mining	House-Hold Mftr.	Non-House-Hold Mftr.	Constr.	Comm.	Trans.	Other Services
	(Full-Time Workers per 1,000 Population)							
A. Rural Areas								
High Agricultural Income								
Punjab	67	0	7	15	5	12	7	22
Haryana	67	0	7	15	5	10	5	23
Medium Agricultural Income								
Karnataka	61	2	14	13	4	11	3	13
Gujarat	53	1	2	17	3	10	5	15
Low Agricultural Income								
Madhya Pradesh	44	3	12	6	4	6	2	12
Bihar	38	3	7	7	1	7	3	11
B. Urban Areas a/								
High Agricultural Income								
Punjab	263	0	10	73	10	70	24	75
Haryana	258	0	10	76	14	66	21	71
Medium Agricultural Income								
Karnataka	247	3	18	70	15	57	25	60
Gujarat	258	1	8	95	9	57	28	59
Low Agricultural Income								
Madhya Pradesh	241	7	18	59	13	51	25	68
Bihar	212	19	8	48	10	50	23	54

a/ Urban includes all localities over 5,000 in population. It encompasses both rural towns and large urban areas.

Source: India (1971a-b, 1981c).

states may stem from greater consumption linkages as consumers channel rising incomes increasingly into nonfoods.

40. In sum, the state-level comparisons generally support the notion that growth in agriculture goes hand-in-hand with development of rural towns and growth in rural nonfarm activity. To quantify the magnitude of the growth multipliers requires more formal modelling approaches.

IV. ESTIMATING RURAL AGRICULTURAL GROWTH MULTIPLIERS

A. Econometric Model

41. Agricultural growth multipliers can be estimated in several ways. This section uses cross-section district and state data in order to estimate econometrically the indirect rural employment and income generated by agricultural growth. An alternative method involves use of input-output and consumption parameters to model the linkages. Since this second method is better able to project urban as well as rural linkages, it is used in Section IV for that purpose and as a check on the econometric estimates of the rural growth multipliers.

42. The following model is an adaptation of the economic base model developed by regional scientists (e.g., Richardson, 1985). It assumes that agricultural output is constrained by technology, land and agroclimate, but that rural nonfarm activity is constrained only by demand. Improved agricultural technology increases farm output and hence the demand for nonfarm inputs and consumer goods. Since agricultural output varies across regions, the following relationship allows a rough estimate of the growth multiplier:

$$RNFY = a + b\ AGY, \qquad [1]$$

where RNFY is rural nonfarm income, AGY is agricultural income and $b = dNFY/dAGY$ is the agricultural income multiplier.

43. Of course, other factors besides the level of agricultural income vary across districts and states, and they too may affect the size of the nonfarm economy. Different types of agriculture may generate different linkages since input intensity and processing requirements vary across cropping systems. Outside of agriculture, analysts generally single out infrastructure, population density and per capita income as candidates most likely to increase growth multipliers. Infrastructure facilitates communication, transport and credit flows and should improve the responsiveness of the nonfarm economy to demand increases from agriculture. Likewise population density, especially in rural areas, may reduce the geographic catchment area necessary to achieve minimum efficient scales of production, reduce transport costs and thereby improve prospects for rural responses. And higher agricultural income per capita should lead farm families to diversify their consumption into nonfoods, thus increasing their incremental expenditure on nonfoods.

44. To take account of these other influences on the growth linkages, consider the following elaboration of [1]:

$$RNFY = a + b\ AGY + c\ AGY*INFR + d\ AGY*POPDEN + e\ AGY*AGYCAP + f\ AGY*IRRIG \qquad [2]$$

where INFR refers to infrastructure, POPDEN to rural population density, AGYCAP to agricultural income per agricultural population and IRRIG to the share of irrigation in total cropped area. Irrigation is used as a proxy for intensity of input use across agricultural zones. The four ancillary variables are included as multiplicative interaction terms because in this form the income multiplier becomes:

$$dRNFY/dAGY = b + c\ INFR + d\ POPDEN + 2\ e\ AGYCAP + f\ IRRIG. \qquad [3]$$

That is, infrastructure, population density, per capita agricultural income, and input intensity of agriculture affect the multiplier itself (the slope) rather than merely the level of nonfarm activity (the y-intercept).

45. Note that other factors influencing the level of nonfarm activity are captured in the error term. Raw material availability, historical accident, location, ethnicity, and differential policies all undoubtedly influence nonfarm activity to some extent. But they are difficult to measure and it seems reasonable to model them as varying randomly across districts.

46. The same model can be used to estimate rural nonfarm employment (RNFL) multipliers by substituting employment for income as follows:

$$RNFL = a + b\,AGY + c\,AGY*INFR + d\,AGY*POPDEN + e\,AGY*AGYCAP + f\,AGY*IRRIG \qquad [4]$$

47. Both equations [2] and [4] have been estimated separately using state and district-level data. For the districts, we have used the same 85-district sample used by Binswanger and Khandker[12] (1988) and Khandker (1988). It is a representative, India-wide sample including districts from Andhra Pradesh, Bihar, Gujarat, Haryana, Jammu and Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Punjab, Rajasthan, Tamil Nadu and Uttar Pradesh. Since income data are not available at the district level, farm and nonfarm income (Y) are estimated as employment (L) times the wage rate (w) divided by the wage share (S_w) in total income ($Y = wL/S_w$).[13] Furthermore, since only agricultural wage data are available, we must assume wage rates are equal in farm and nonfarm activities. For infrastructure, we have used road density per square kilometer, although rural bank branches and rural electrification are highly correlated and produce similar results. Farm and nonfarm income data are available for each

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[12] We are grateful to Shahidur Khandker for access to the agricultural and infrastructural variables necessary for estimating this model. We have supplemented the employment figures by returning to the population census (India, 1981b) to break out nonfarm employment in rural towns as well as rural areas and large urban centers.

[13] Translating from wage to income multipliers requires the following adjustment. We wish to estimate the income multiplier ($dRNFY/dAGY = b$) from $RNFY = a + b\,AGY$. But data constraints require us to estimate a wage multiplier, b', instead from $RNFW = a' + b'\,AGW$. The wage equation can be rewritten as $RNFY*S_{wn} = a' + b'\,AGf * S_{wn}$. So long as wage shares of total income, S_w, remain constant, we can compute b from b' as follows: $b = b' * S_{ws}/S_{wn}$. Calculations based on Hazell and Ramasamy (1989) place S_{ws}/S_{wn} at 0.82. hence the wage share adjustment described in Table A.13.

state, but in this case there is no breakdown among rural areas, rural towns and large urban centers. Footnote 13 describes the allocation methods used.

48. We estimated the model separately for rural areas (RNFY), rural towns (RTNFY), and the expanded rural region (RRTNFY) encompassing both. This provides a useful indication of the spatial dispersion of the rural demand linkages. We also estimated the model by both OLS and 2SLS. The latter seemed necessary to correct for potential endogeneity problems with some of the right-hand side variables. For example, it could be argued that the rural nonfarm economy has its own stimulatory effects on agriculture (the urban growth pole model), in which case RNFY and AGY would be simultaneously determined. Also, population and infrastructure may be concentrated in regions with higher agricultural potential, leading to selectively bias problems.

49. The econometric estimates are reported in Appendix Tables A.12 - A.15. Because of multicollinearity problems, the irrigation variable was never significant, hence we dropped it from the final runs. As expected, the Breuch-Pagan test revealed heteroskedasticity in the district data. Consequently, all district regressions were run using the Prais-Houthaker adjustment to correct the problem.

B. Income Multipliers

50. The income multipliers from these regression coefficients suggest three major conclusions. First, on average, a one hundred rupee increase in agricultural income will generate about an additional 64 rupees in rural nonfarm income, 25 rupees in rural areas and 39 in rural towns (Table 13).[14]

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[14] Although this is our best estimate, the actual value probably ranges anywhere between 54 and 79 rupees. This interval is that computed from the state-level regressions. They offer an advantage in that farm and nonfarm income are available for each state, while we must extrapolate based on wage earnings for the districts. Yet with the state data, a different difficulty emerges; we must partition state-wide nonfarm income among rural areas, rural towns and large urban centers. There are several ways to do this. The upper bound multiplier arises by taking rural nonfarm income as proportional to its share in state nonfarm employment, that is RNFY = RNFL*(state NFY/state NFL). The lower bound takes per capita rural nonfarm income as equal to earnings in agriculture, that is RNFY = RNFL * (state AGY/state AGL).

Table 13: Rural Income Multipliers Across States with Differing Agricultural Incomes

	Change in Nonfarm Income Resulting from One Rupee Increase in Agricultural Income		
	Rural Areas	Rural Towns[a/]	Rural Areas Plus Rural Towns[b/]
Punjab/Haryana	.34	.59	.93
All India average	.25	.39	.64
Karnataka/Gujarat	.24	.40	.63
Madhya Pradesh/Bihar	.18	.28.	.46

a/ Rural towns are localities between 5,000 and 100,000 in population.

b/ Since separate equations are obtained from the 2SLS-PH district regressions as described in Table A.13. The state-specific multipliers are similarly derived. They vary because the average road density, per capita income and population density all differ across states. For details, see Table A.14.

51. Second, all of the ancillary factors -- infrastructure, population density and per capita agricultural income -- increase the agricultural growth multiplier. Take roads as an example since policymakers can most easily influence infrastructure. Given the parameters reported in Table A.13, a 10 percent increase in road density will increase the aggregate rural plus rural town multiplier by 2.2 percent, to .66.[15]

52. Third, because the infrastructure, population density and per capita agricultural income differ so markedly across states (Table A.14), the coefficients from equation [2] can be used to calculate multiplier differences among them. Reported in Table 13, the multipliers indicate a considerable range across regions. While one hundred rupees of agricultural income will generate 93 rupees in rural (including rural towns) nonfarm income in Punjab and Haryana, it will only support 46 rupees of nonfarm income in Bihar and Madhya Pradesh. Higher consumption linkages and higher input intensity in agriculture account for the substantially higher linkages in the high-productivity agricultural states.

C. Employment Multipliers

53. Both the state and district regressions in Table A.16 project employment multipliers. They indicate that every 100,000 rupees in additional farm income will generate 3.7 nonfarm jobs in rural areas plus rural towns. But statistically, the regression results were much less robust than was the case with the income multipliers.

D. Projections

54. The estimated regression parameters provide a basis for forecasting the nonfarm income and employment that might materialize under different agricultural growth

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[15] Unfortunately for policymakers, this does not mean that building more roads will guarantee higher nonfarm growth linkages. Since all infrastructure variables are highly correlated (with a correlation coefficient of .8), it is not possible to separate out the individual effects of roads from banks, electricity, or telephones, at least not with these cross-sectional data. Rerunning the model using bank density rather than roads, for example, produces virtually identical parameters. So to achieve the 2.2 percent increase in multipliers, it will probably be necessary to develop infrastructure across the board by 10 percent. Khandker (1989) is more successful in isolating the separate contributions of different kinds of rural infrastructure, but he has access to pooled time-series, cross-section data for the same districts.

scenarios. Given assumed growth rates for agricultural income, population and road density, the district-level regressions in Table A.13 are used to project the changes in the income multiplier for selected years between 1981 and 2040. The product of the multiplier and the projected agricultural income for each year then provides a forecast of incremental rural nonfarm income. Nonfarm employment can be projected by dividing the forecasted rural nonfarm income by per capita earnings.[16] The latter is easily projected each year from the assumed growth in agricultural income and population. We choose to project nonfarm employment in this indirect way rather than using the employment regressions in Table A.16 because the latter are statistically so weak.

55. Projections are reported in Tables 14a-14c under the following three assumptions about the agricultural growth rates; a continuation of past trend, 2.4 percent; the World Bank's target, 3.25 percent; and the target rate set by the National Planning Commission, 4 percent. The nonfarm projections comprise an aggregate of rural areas plus rural towns, and they are based on the 2SLS-PH regressions in the last block of Table A.13. All the projections assume a population growth rate of 2.2 percent and an unchanging density of rural roads.

56. The tables also include projections for agricultural employment. These are obtained by multiplying the projected growth in agricultural output by an agricultural employment elasticity each period. Three alternative elasticities are used, corresponding to different scenarios for agricultural growth.

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[16] As before, we take per capita nonfarm income as equal to agricultural income in rural areas but double that in rural towns. If women's nonfarm earning differ from those of men by the same 20 percent margin prevailing in agriculture (Acharya 1988), these projections may understate employment growth. Since women account for only 10 percent of the measured rural nonfarm labor force, an appropriately weighted downward adjustment in per capita nonfarm income will increase the employment growth rate by only 2 percent. This amounts to a change in the 2nd decimal place, increasing nonfarm employment growth, for example, from 2.11 percent per year to 2.15 percent. Of far greater importance is the large volume of unmeasured female employment that we have no reliable means of imputing at all.

57. Scenario I: The status quo assumes that the pattern of growth - in terms of the crop mix, irrigated versus rainfed, and area versus yield growth - will be the same as observed in the period 1968/69-1970/71 to 1976/77-1978/79. For this scenario, we use Tyagi's (1981) estimate of the agricultural employment elasticity of 0.75.

58. Scenario II: Irrigation assumes that future agricultural growth will arise from greater emphasis on irrigation, a concomitant shift towards more paddy and wheat, and a modest increase in per hectare yields. Specifically, we assume that 50 percent of future agricultural growth will arise from increases in the gross cropped area, 20 percent from increases in the crop mix in favor of rice and wheat, and 30 percent from higher yields. Then, using relevant employment elasticities reported by Tyagi[17], each one percent growth in agricultural output will lead to:

$$1.0[(1.05)(0.5) + (0.76)(0.2) + (0.66)(0.3)] = 0.88 \text{ percent}$$

growth in agricultural employment.

59. Scenario III: rainfed agriculture assumes future growth will depend on rainfed agriculture, with a shift away from sorghum and millets and into oilseeds, sugarcane, and less traditional crops. In the absence of any estimated employment elasticities for most of these crops, we simply assume that the growth will be predominantly yield driven and use Tyagi's (1981) aggregate yield employment elasticity of 0.6.

60. Since per capita agricultural income is assumed to increase over time, so too do the income multipliers in Tables 14a-14c. As per capita income rises, consumers increasingly diversify their consumption into nonfoods. The strength of this relationship is shown in Table A-19, where states with higher agricultural incomes spend

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[17] Tyagi (1981) gives employment elasticities for selected crops; paddy 0.73; wheat 0.79, sorghum 0.44, sugarcane 0.30, millets 0.15 percent. He also gives aggregate elasticities with respect to changes in the gross cropped area (1.05), a cropping pattern index (0.47) and yield (0.66).

a higher share of their income on nonfarm commodities and services. Moreover, as incomes have risen over time, the average income share spent on nonfoods has increased substantially, from 23 percent to 34 percent between the mid-1960s and the early 1980s (Table A-20). So the race between population and farm income, because of its influence on per capita income will have a major bearing on the magnitude of the farm-nonfarm linkages. Given 2.2 percent population growth, and an initial multiplier of 0.64, the multiplier increases by 0.02 percent, 0.88 percent or 1.64 percent per annum depending on whether agriculture grows at 2.4, 3.25 or 4 percent, respectively.

61. Nonfarm income will grow faster than agricultural income under each of the three levels of agricultural growth assumed in Table 14. So will nonfarm employment, although it will not grow as fast as nonfarm income. This difference arises because, as earnings rise in agriculture, they pull up rural nonfarm earnings in tandem. Consequently, a given nonfarm income increment will represent fewer jobs at a high wage than at a low wage. Even so, nonfarm employment will grow faster than agricultural employment under all scenarios.

62. Table 15 shows the prospects for growth in farm and nonfarm employment given a wider range of agricultural growth rates and two alternative rates of population growth (1.8 percent and 2.2 percent). If agricultural output only grows by one percent per annum, then total employment will grow at between 1.16 and 1.32 percent depending on whether the agricultural growth is oriented towards rainfed or irrigated areas. This would be less than the estimated growth in the rural plus rural town labor force, which is currently increasing at around 2.2 percent per annum.

63. An agricultural growth rate of 2.4 percent per year would enable the growth in total employment to keep pace with the labor force, if the agricultural growth is irrigation led. However, growth in rainfed agriculture cannot generate adequate growth

in total employment unless agricultural output grows by at least 3.25 percent per annum.

64. Note that growth in nonfarm employment contributes relatively more to the increase in total employment when agricultural growth is low and/or has a low employment elasticity. It will be particularly important in helping to absorb projected increases in the rural labor force if agriculture grows at less than 2.4 percent, especially if future growth is focused on rainfed a

agriculture.

65. For high rates of agricultural growth, Table 15 suggests that total employment would quickly outstrip the growth in the total rural plus rural town labor force. The surplus labor demand would clearly have to be resolved through higher wage rates or urban-rural irrigation, neither of which is adequately captured in our model.

Table 14a: Projections of Rural Plus Rural Town Income and Employment in India Through the Year 2040: Agricultural Growth Continues at Trend Rate (2.4 percent)

Year	Agr. Income ($Rs10^9$)	Nonfarm Income Multiplier (Rs)	Nonfarm Income ($Rs10^9$)	Nonfarm Employment (Million)	Agricultural Employment Scenario I (million)	Agricultural Employment Scenario II (million)	Agricultural Employment Scenario III (million)	Total Employment Scenario I (million)	Total Employment Scenario II (million)	Total Employment Scenario III (million)
1981	446	0.635	184	47	147	147	147	194	194	194
1985	490	0.638	212	54	158	160	155	211	213	209
1990	552	0.646	252	63	172	177	167	235	240	230
2000	700	0.645	347	85	206	218	193	291	303	277
2010	887	0.648	468	112	246	269	222	358	381	334
2020	1,125	0.648	622	146	294	332	256	440	478	403
2030	1,426	0.646	817	188	352	409	296	540	597	484
2040	1,808	0.641	1062	240	421	504	341	660	744	581
Compound Growth Rates	2.4	0.02	3.02	2.81	1.80	2.11	1.44	2.10	2.31	1.88

Assumptions: Growth rates: population, 2.2 percent; agricultural income, 2.4 percent; roads, 0 percent.
Agricultural employment elasticity: Scenario I, 0.75; Scenario II, 0.88; Scenario III, 0.6.

Table 14b: Projections of Rural Plus Rural Town Income Employment in India Through the Year 2040: Agricultural Growth Achieves World Bank Target (3.25 percent)

Year	Agr. Income ($Rs10^9$)	Nonfarm Income Multiplier (Rs)	Nonfarm Income ($Rs10^9$)	Nonfarm Employment (Million)	Agricultural Employment Scenario I (million)	Agricultural Employment Scenario II (million)	Agricultural Employment Scenario III (million)	Total Employment Scenario I (million)	Total Employment Scenario II (million)	Total Employment Scenario III (million)
1981	446	0.635	184	47	147	147	147	194	194	194
1985	607	0.658	223	54	162	164	159	216	219	213
1990	595	0.687	283	65	182	189	175	248	255	240
2000	819	0.750	444	92	232	251	213	324	343	304
2010	1128	0.819	686	129	295	333	257	424	461	386
2020	1553	0.895	1,050	178	376	441	312	553	618	489
2030	2138	0.977	1,598	243	478	584	378	721	828	621
2040	2944	1.066	2,421	332	608	775	459	940	1107	791
Compound Growth Rate	3.25	0.88	4.46	3.38	2.44	2.86	1.95	2.71	3.00	2.41

Assumptions: Growth rates: population, 2.2 percent; agricultural income, 3.25 percent; roads, 0 percent.
Agricultural employment elasticities: Scenario I, 0.75; Scenario II, 0.88; Scenario III, 0.6.

Table 14c: Projections of Rural Plus Rural Town Income and Employment in India Through the Year 2040: Case of High Agricultural Growth (4 percent)

Year	Agric. Income (Rs 10^9)	Nonfarm Income Multiplier (Rs)	Nonfarm Income (Rs 109)	Nonfarm Employment (Million)	Agricultural Employment Scenario I (million)	Agricultural Employment Scenario II (million)	Agricultural Employment Scenario III (million)	Total Employment Scenario I (million)	Total Employment Scenario II (million)	Total Employment Scenario III (million)
1981	446	0.635	184	47	147	147	147	194	194	194
1985	522	0.676	234	55	165	169	161	220	224	217
1990	635	0.732	313	68	192	200	182	259	268	250
2000	948	0.858	556	101	257	283	238	358	384	331
2010	1391	1.000	977	148	346	400	292	494	548	440
2020	2059	1.188	1711	217	465	566	370	682	782	587
2030	3048	1.462	2911	317	625	800	469	942	1117	786
2040	4512	1.857	5230	464	840	1130	595	1303	1594	1059
Compound Growth Rate	4.0	1.64	5.84	3.97	3.00	3.52	2.40	3.29	3.64	2.92

Assumptions: Growth rates: population, 2.2 percent; agricultural income, 4 percent; roads, 0 percent.
Agricultural employment elasticities: Scenario I, 0.75; Scenario II, 0.88; Scenario III, 0.6.

Table 15: Projected Employment Growth Rates in Rural Areas Plus Towns, India 1981-2040 Under Alternative Population and Agricultural Growth Scenarios

Agricultural Output	Nonfarm Employment	Agricultural Employment			Total Employment		
		Scenario I	Scenario II	Scenario III	Scenario I	Scenario II	Scenario III
		Compound Annual Growth Rates, 1981-2040					
Population Growth 2.2%							
1.0	2.25	0.75	0.88	0.60	1.25	1.32	1.16
2.4	2.81	1.80	2.11	1.44	2.10	2.31	1.88
3.25	3.38	2.44	2.86	1.95	2.71	3.00	2.41
4.0	3.97	3.00	3.52	2.40	3.25	3.64	2.92
6.0	5.73	4.50	5.28	3.60	4.88	5.40	4.38
Population Growth 1.8%							
1.0	1.94	0.75	0.88	0.60	1.12	1.20	1.03
2.4	2.63	1.80	2.11	1.44	2.04	2.25	1.81
3.25	3.24	2.44	2.86	1.95	2.67	2.96	2.36
4.0	3.86	3.00	3.52	2.40	3.25	3.61	2.88
6.0	5.06	4.50	5.28	3.60	4.86	5.38	4.35

Scenario I assumes the same pattern of agricultural growth as occurred during 1968/69-1970/71 to 1976/77-1978/79; Scenario II assumes an irrigation intensive growth strategy; Scenario III assumes agricultural growth will be predominantly focussed in rainfed areas.

Assumptions: Growth rates: agricultural income same as the growth in agricultural output; roads 0 percent. Agricultural employment elasticities: Scenario I, 0.75; Scenario II, 0.88; Scenario III, 0.6.

66. The lower rate of population growth (1.8 percent) has a surprisingly small effect on the employment projections in Table 15. Since, other things being equal (including per capita incomes), the multiplier increases with population density (Table A-13), then the lower population growth rate leads to a marginally smaller increase in nonfarm income and employment.

67. Caution. The above projections pertain only to the growth in nonfarm income and employment that might arise as a consequence of the indirect effects of agricultural growth. Additional growth in nonfarm income and employment will undoubtedly arise from increasing export opportunities from rural areas, both to large urban areas within India and to overseas markets. But these sources of growth are likely to continue to provide a relatively small share of the total market for rural nonfarm activity.

V. PROJECTIONS OF NATIONAL MANUFACTURING AND TERTIARY DEMAND RESULTING FROM AGRICULTURAL GROWTH

A. Semi-Input-Output Modeling of Growth Multipliers

68. Since growing agricultural output stimulates demand for consumer goods, production inputs and processing services, it is possible to model the demand increments directly using input-output coefficients and consumption parameters. Unlike the cross-section econometrics, this approach allows estimation of changes in total national demand for nonfarm products. Because agriculture clearly drives changes in the rural nonfarm economy, it is possible to estimate the rural growth linkages econometrically as in Section IV. But in large urban centers, export demand, government spending and other forces outside of agriculture influence the level of nonfarm activity in a major way. Since agriculture is not the only engine stimulating

large urban center industrial growth, input-output techniques are useful for isolating the demand increments attributable directly to agriculture.

69. The semi-input-output method, a variant of Leontief's input-output model, seems most appropriate for estimating Indian agricultural growth linkages.[18] The key distinction between it and standard input-output analysis lies in its assumption of what constrains agricultural output. Input-output analysis assumes production in all sectors is demand constrained. It presumes producers are able to supply unlimited additional quantities of output at constant cost. But semi-input-output analysis maintains the assumption of perfectly elastic output supply holds only for some sectors, not for others. For agriculture, in particular, it seems doubtful that farmers could increase output in unlimited volume at constant cost. If they could, fewer rural households would go hungry. It seems more plausible, as the semi-input-output model presumes, that agricultural output is constrained, not by demand, but rather on the supply side by technology, land and labor availability. This assumption leads to smaller, and more realistically sized multipliers than many analysts have estimated using input-output techniques.[19]

70. This is not to ignore the heroic assumptions remaining in semi-input-output models. The perfectly elastic supply assumed for nonfarm output may approach reality in rural regions where frequent excess capacity and the seasonability of rural labor markets allows highly elastic supply response at constant cost. But at the national level, the constant price assumption is less defensible. Because of the complexity of general equilibrium modeling and because the semi-input-output multipliers do at least place upper bounds on the growth multipliers, we proceed by casting the usual blind eye to price endogeneity. Moreover, de Janvry and Subbarao (1986) have estimated

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[18] See Bell and Hazell (1980) for a detailed formal presentation of the model.

[19] See Krishna (1975), Bhalla (1989) and Ghosh et al. (1988) for typical examples.

a general equilibrium model for India, so it will be possible to contrast the semi-input-output results with theirs.

71. The following estimates use a five sector version of the semi-input-output model. The five sectors include three in agriculture, irrigated (I), rainfed (A) and nontradable (N) agriculture, in addition to manufacturing (M) and tertiary activity (T). Nontradable agriculture comprises high-value livestock and horticultural products. We assume the output of irrigated and rainfed agriculture is constrained by technology and resource constraints, but that output in the remaining sectors is highly elastic and constrained only by domestic demand. This is clearly the case for most tertiary, horticultural and livestock products, since their perishability or location specificity severely limits international trading possibilities. It is less obvious with manufactured goods, and our assumption is designed to capture the effect of trade restrictions (both domestic and foreign) that essentially pre-determine the amount that can be exported.

72. As new technology increases irrigated and rainfed agricultural output, the nontradable agriculture, N, and nonfarm sectors, M and T, respond to the consumption and production linkages that ensue. Hence the key parameters affecting the magnitude of the linkages are the input-output coefficients, the marginal propensity to consume nontradable foods and nonfarm goods, savings and tax rates (leakages in that they represent income not spent on nonfarm goods), and the value-added share in gross output (which allows translation from gross output to income multipliers). Appendix B develops the model formally,[20] while Appendix Table A.19 displays the parameters used to obtain the following results.

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[20] See Bell and Hazell (1986), Hazell (1984) and Haggblade and Hazell (1989) for additional applications.

B. **Results**

73. Table 16 contrasts the sectoral gross output and income multipliers that arise from growth in irrigated and rainfed agriculture. A 100 rupee increase in irrigated agricultural output generates 105 rupees of additional output in manufacturing, 114 rupees of additional tertiary output and 45 rupees of additional nontradable agricultural output. This amounts to a total nonfarm output multiplier of 2.19, and a total output multiplier of 2.64. In contrast, rainfed agriculture, because of its less intense use of manufactured and tertiary inputs (Table A.19), generates nonfarm gross output multipliers that are about five to ten percent smaller.

74. An income multiplier gives the amount of income (value added) generated in a particular sector as a result of a one rupee increase in income (value added) in either irrigated or rainfed agriculture. These multipliers are relatively small for manufacturing because of the low value added to gross output ratios in that sector. They are also relatively large for the tertiary sector. Table 16 demonstrates that irrigated agriculture has larger nonfarm income multipliers than rainfed agriculture, and that the latter are about 20-25 percent smaller.

75. The figures in parentheses in Table 16 show the percentage of the gross output multiplier that is attributable to household consumption linkages rather than inter-industry production linkages. For the total nonfarm economy, only 6 percent of the gross output multiplier is attributable to production linkages when the expansion is driven by rainfed agriculture. The share increases to 18 percent with irrigated agriculture because of its higher dependence on purchased inputs.

76. Taking a base-year weighted average of the irrigated and rainfed agricultural multipliers, Table 16 indicates that a one rupee increase in agricultural output will generate about 2.11 rupees in gross output of nonfarm goods and services. This corresponds to an income multiplier of 1.35, nearly twice as large as the 0.66 income

Table 16: National Agricultural Output and Income Multipliers for Irrigated versus Rainfed Agriculture

	Irrigated Agriculture		Rainfed Agriculture		Total Crops[a]
ONE RUPEE INCREASE IN CROP OUTPUT					
Resulting Increase in Sector Gross Output					
Manufacturing	1.05	(77)	0.94	(92)	0.98
Tertiary	1.14	(87)	1.11	(95)	1.12
Nontradable Agriculture	0.45	(94)	0.50	(90)	0.48
Total Nonfarm	2.19	(82)	2.05	(94)	2.11
Total	2.64	(84)	2.55	(93)	2.59
ONE RUPEE INCREASE IN CROP INCOME					
Resulting Increase in Sector Income					
Manufacturing	0.47		0.35		0.39
Tertiary	1.09		0.88		0.96
Nontradable Agriculture	0.51		0.47		0.48
Total Nonfarm	1.56		1.23		1.35
Total	2.07		1.70		1.83

a/ Weighted average using base-year gross output (income) weights of 0.4 (0.36) for irrigated crops and 0.6 (0.64) for rainfed crops.

Note: Figures in parentheses are the percentages of the increases in total sectoral outputs that are attributable to consumption linkages.

multiplier estimated econometrically for rural areas alone. Moreover, the gross output multiplier of 2.11 is also much higher than the multiplier of 1.35 implicit in de Janvry and Subbarao's (1986) general equilibrium results. The discrepancy undoubtedly reflects the extreme elasticity assumptions made in a semi-input-output model. By assuming that the supplies of manufacturing, tertiary and nontradeable agricultural output are perfectly elastic, the model embodies an optimistic view of the ability of the Indian economy to expand in response to increases in domestic demand. The semi-input-output multipliers must therefore be viewed as upper bounds on the true parameter values.

77. The semi-input-output model can be used to project growth in nonfarm output corresponding to different scenarios for agricultural growth. Table 17 shows that if agricultural output is driven by irrigated agriculture, and that an average growth rate of 2.4 percent per annum is sustained until the year 2040, then this will stimulate an average annual growth rate of 1.92 percent in manufacturing output, 2.54 percent in tertiary output, and 3.8 percent in nontradable agricultural output. The nonfarm growth rates will be about 5 percent lower if agricultural growth is driven by rainfed agriculture. Both sets of growth rates are reduced by about one-third if the semi-input-output multipliers are scaled down to be consistent with our econometric estimates;that is, so that the total nonfarm income multiplier is 0.64 (see footnote 6 in Table 17). However, the multipliers do not increase very much when we allow for technological change that increases the multiplier over time (Table 17).

78. If agricultural growth is to have a significant impact on the growth of the national nonfarm economy, then Table 17 shows that agricultural growth rates of at least 4 percent will be required. This suggests that the current growth in Indian manufacturing of about 8 percent per annum must be driven more by export and urban demand than by agricultural growth through its rural-urban linkages. Future manufacturing growth may also have to depend on these same sources of demand growth. The prospects for high-value livestock and horticultural products (nontradable agriculture) is more encouraging. The model projects growth rates of about 4 percent per annum for these products even given relatively modest rates of agricultural growth.

79. Caution: As with our econometric based forecasts, the above projections only indicate the growth in nonfarm activity resulting from agricultural growth. Growth in exports and demand in large urban centers will also play a role in driving manufacturing, tertiary and nontradeable agricultural output.

Table 17: Compound Annual Growth Rates in Nonfarm Output and Nontradable Agricultural Output Under Alternative Agricultural Growth Rates

Annual Growth in Agricultural Output[a/]	Resulting Growth Rate in Output of Other Sectors							
	Manufacturing		Tertiary		Nonfarm		Nontradable Agriculture	
	Projection	Range	Projection	Range	Projection	Range	Projection	Range
i) Growth Originates in Irrigated Agriculture								
1.0	0.72	0.38-0.72	1.05	0.57-1.06	0.86	0.46-0.86	1.89	1.13-1.90
2.4	1.9	1.15-1.93	2.54	1.60-2.55	2.19	1.35-2.21	3.80	2.66-3.81
3.25	2.73	1.78-2.74	3.43	2.32-3.45	3.04	2.01-3.06	4.81	3.55-4.83
4.0	3.46	2.36-3.47	4.22	3.01-4.24	3.80	2.65-3.82	5.66	4.32-5.68
5.5	4.45	3.22-4.47	5.27	3.94-5.29	4.82	3.54-4.84	6.77	5.35-6.78
6.0	5.46	4.13-5.48	6.30	4.90-6.32	5.85	4.48-5.87	7.84	6.36-7.86
ii) Growth Originates in Rainfed Agriculture								
1.0	0.65	0.34-0.66	1.03	0.57-1.04	0.81	0.44-0.82	2.02	1.21-2.03
2.4	1.86	1.07-1.81	2.58	1.60-2.51	2.11	1.30-2.12	3.96	2.77-3.98
3.25	2.57	1.65-2.59	3.39	2.32-3.41	2.95	1.94-2.96	4.99	3.68-5.00
4.0	3.29	2.23-3.31	4.18	3.01-4.20	3.78	2.60-3.72	5.85	4.46-5.86
5.0	4.27	3.07-4.29	5.22	3.94-5.24	4.71	3.46-4.73	6.95	5.50-6.97
6.0	5.27	3.97-5.29	6.26	4.90-6.28	5.73	4.38-5.75	8.03	6.52-8.05

a/ Tradable (crop) agricultural output only.
b/ The lower range value was derived by scaling all the national SIO multipliers down so that the total nonfarm income multiplier is 0.64, the same as our econometric estimate. The upper range value is based on the assumption that the full SIO multiplier increases by 2.5% per annum to reflect technological change and shifting expenditure patterns.

VI. CONCLUSIONS

80. This paper has highlighted the importance of the rural nonfarm economy in determining current and future incomes and employment in India's rural areas and rural towns. It is a particularly crucial sector for the welfare of the poor and, unless agricultural growth increases sharply, it will be instrumental in creating sufficient productive employment to absorb projected increases in the rural labor force in the decades ahead.

81. The growth of the rural nonfarm sector is driven primarily by agricultural growth. We estimate that each rupee of value added created in agriculture leads to Rs 0.64 of additional value added in nonfarm activities in India's rural areas plus rural towns.

82. But the multipliers are not invariant. They increase with agricultural development. Thus, the multiplier is Rs 0.93 in Punjab and Haryana but it stands at only Rs 0.46 in Madhya Pradesh and Bihar. And all evidence suggests that the multipliers will increase over time. Both production and consumption linkages have grown substantially, buoyed by the rising input-intensity of agriculture and the growing incomes which stimulate consumer diversification of spending into nonfoods.

83. Moreover, the magnitude of the growth linkages can be increased through appropriate governmental policies and investments. Our analysis, as well as Khandker's (1989), has identified the importance of rural infrastructure (roads, electrification, banking services, etc.) in enhancing the size of the multipliers. Irrigated agriculture also has larger multipliers than rainfed agriculture. And, as shown by Hazell and Roell (1983), Mellor

and Lele (1973), Haggblade and Hazell (1989) amongst others, the multipliers are bigger for small- to medium-sized farms than for very large farms. Appropriate regional and farm targeting of agricultural technology and investments, supported by adequate investments in rural infrastructure, may, therefore, significantly enhance the size of the indirect benefits emanating from agricultural growth.

84. Because much current writing emphasizes the need for investments in infrastructure, policymakers can all too easily overlook the collateral need for investments in people. Since services will be among the most rapidly growing rural nonfarm activities, investment in human capital will likely be essential for realizing those potential gains.

85. Our analysis also confirms the importance of rural towns as magnets for the nonfarm spinoffs of agriculture-led growth. By providing nonfarm enterprises with larger markets, rural towns offer firms the potential to exploit economies of scale. Prospects for sharing equipment as well as the emergence of repair and support facilities induce enterprise establishment in rural towns. This may in part explain the predominance of intermediate-sized towns in regions of high agricultural productivity. It suggests that agricultural growth may be instrumental to efforts at fostering urban decentralization.

86. Government policies towards small, rural nonfarm firms are also important. Subsidies, investment and tax codes and related legislation that discriminate against small rural firms, together with historic urban policy biases, will need to be redressed if small, rural enterprises are to achieve their full potential for income generation and economic decentralization.

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APPENDIX A:
SUPPLEMENTARY TABLES

Table A.1: Changes in Population, Workforce and Nonfarm Employment in India, 1961-81

Year	Rural Areas	Urban Areas: Rural Towns	Urban Areas: Large Urban	Urban Areas: Total	Total National
i) Population					
1961	360	41	38	79	439
1971	439	48	61	109	548
1981	502	62	94	156	658
ii) Full-time Workers					
1961	162.2	13.8	12.6	26.4	188.7
1971	148.4	13.8	18.2	32.0	180.4
1981	174.5	17.8	27.7	45.6	220.1
iii) Nonfarm Workers					
1961	29.2	10.9	12.2	23.1	52.3
1971	22.5	10.6	17.3	27.9	50.4
1981	32.9	13.8	26.5	40.4	73.3

Source: Population censuses of 1961, 1971, 1981. See India (1961a-d, 1971a-b, 1981b).

Table A.2: Income Distribution by Farm Size, Rural India

Cropped Area	Household Income	Share of Total Income, by Source			
		Crops	Farm Wages	Nonfarm and Livestock	Total
(Ha./Household)	(Rs./Household)			(Percent)	
I) Poor Crop Year (1968/69)					
Zero	1,734	0	40.5	59.5	100
0 - 1.0	1,618	37.6	32.3	30.0	100
1.1 - 4.5	2,519	72.4	10.1	17.6	100
4.6 - 10.5	4,763	85.5	1.8	12.6	100
More than 10.6	7,228	78.0	.9	21.1	100
II) Good Crop Year (1970/71)					
Zero	1,865	0	37.7	62.3	100
0 - 1.0	1,630	38.7	26.9	34.4	100
1.1 - 4.5	2,889	69.3	9.9	20.8	100
4.6 - 10.5	5,271	86.2	2.5	11.3	100
More than 10.6	11,082	96.4	.2	3.4	100

Source: NCAER (1975)

Table A.3: Income Distribution by Farm Size, Rural India 1970/71 and 1980/81

Category	1970/71 Income					1981/82 Income				
	Total	Ag.	Wages	Other	Total	Total	Ag.	Wages	Other	Total
	(Rs)			(%)		(Rs)			(%)	
Land Owners	6,979	75	11	14	100	7,938	65	12	24	100
Marginal	4,468	47	26	26	100	5,894	42	22	36	100
Small	6,757	78	9	13	100	7,700	68	10	22	100
Medium	10,639	89	4	7	100	11,452	79	5	15	100
Large	19,105	93	2	6	100	16,500	83	2	15	100
Landless	4,309	6	56	38	100	5,910	19	42	38	100
Ag. wage earners	3,580	5	87	7	100	4,834	21	56	23	100
Others	5,277	6	65	29	100	7,265	18	51	31	100
Total		**60**	**21**	**19**	**100**		**53**	**19**	**27**	**100**

Source: NCAER (1986a)

Table A.4: Locational Changes in Population, Workforce and Nonfarm Employment in India, 1961-81

Year	Rural Areas	Urban Areas: Rural Towns	Urban Areas: Large Urban	Urban Areas: Total	Total National
			(Percent)		
I) Population					
1961	82.0	9.3	8.7	18.0	100
1971	80.1	8.8	11.1	19.9	100
1981	76.2	9.4	14.3	23.7	100
II) Full-time Workers					
1961	86.0	7.3	6.7	14.0	100
1971	82.3	9.8	8.0	17.7	100
1981	79.3	8.2	12.5	20.7	100
III) Nonfarm Workers					
1961	55.8	20.8	23.3	44.2	100
1971	44.6	21.0	34.4	50.4	100
1981	44.9	18.8	36.2	55.1	100

Source: Population censuses of 1961, 1971, 1981. See India (1961a-d, 1971a-b, 1981b). Raw data are reproduced in Appendix Table A.1.

Table A.5: Measured Female Employment Density by Activity, India 1961-81

		Non-Agriculture						
	Agriculture	Total	Mining	House-Hold Mftr.	Non-House-Hold Mftr.	Constr.	Trans.	Other Services	Total
	(Full-Time Female Workers per 1,000 Population)								
Rural									
1961	132	22	-	11	1	0	2	8	154
1971	57	7	0	2	1	0	1	2	64
1981	70	9	0	3	2	0	1	2	79
Total									
1961	111	25	-	11	2	1	2	10	136
1971	47	10	0	2	2	0	1	4	57
1981	55	13	0	3	2	1	1	5	68

Source: India (1961a-d, 1971a-b, 1981c).

Table A.6: Urban Population Distribution Across States with Differing Agricultural Incomes: India 1981

State	Urban Town Size (in thousands) 5-50	50-200	Over 200	All Urban
	(Percentage State Population)			
High Agricultural Income				
Punjab	11.1	5.6	11.0	27.7
Haryana	7.2	12.2	2.5	21.9
Medium Agricultural Income				
Karnataka	10.4	5.3	13.2	28.9
Gujarat	8.4	6.3	14.1	30.0
Low Agricultural Income				
Madhya Pradesh	7.1	5.3	8.0	20.3
Bihar	3.9	3.6	5.0	12.5

Source: Economic Intelligence Service (1988) and India (1981b).

Table A.7: Rural–Urban Differences in Nonfarm Activity in States with Differing Agricultural Incomes, India 1981

	Total Nonfarm	Mining	House-Hold Mftr.	Non-House-Hold Mftr.	Constr.	Comm.	Other Trans.	Services
	(Full-Time Workers per 1,000 Population)							
High Agricultural Income								
Punjab								
Urban/rural	3.9	-	1.4	4.9	2.0	5.8	3.4	3.4
Urban	263	0	10	73	10	70	24	75
Rural	67	0	7	15	5	12	7	22
Haryana								
Urban/rural	3.9	-	1.4	5.1	2.8	6.6	4.2	3.1
Urban	258	0	10	76	14	66	21	71
Rural	67	0	7	15	5	10	5	23
Medium Agricultural Income								
Karnataka								
Urban/rural	4.0	1.5	1.3	5.4	3.8	5.2	8.3	4.0
Urban	247	3	18	70	15	57	25	60
Rural	61	2	14	13	4	11	3	13
Gujarat								
Urban/rural	4.9	1.0	4.0	5.6	3.0	5.7	5.6	3.9
Urban	258	1	8	95	9	57	28	59
Rural	53	1	2	17	3	10	5	15
Low Agricultural Income								
Madhya Pradesh								
Urban/rural	5.5	2.3	1.5	9.8	3.3	8.5	12.5	5.7
Urban	241	7	18	59	13	51	25	68
Rural	44	3	12	6	4	6	2	12
Bihar								
Urban/rural	5.6	6.3	1.1	6.9	10	7.1	7.7	4.9
Urban	212	19	8	48	10	50	23	54
Rural	38	3	7	7	1	7	3	11

a/ Urban includes all localities over 5,000 in population. It encompasses both rural towns and large urban areas.

Source: India (1971a-b, 1981c).

Table A.8: Changing Composition of Nonfarm Activity Across States with Differing Agricultural Incomes, India 1971-81

	1971-81 Change in Nonfarm Employment Density							
	Total Nonfarm	Mining	House-Hold Mftr.	Non-House-Hold Mftr.	Constr.	Comm.	Trans.	Other Services
	(Full-Time Workers per 1,000 Population)							
A. Rural Areas								
High Agricultural Income								
Punjab	7.2	0	-3.3	5.4	0	2.4	3.1	-.4
Haryana	9.6	-.3	-1.9	6.0	1.4	2.1	2.4	-.2
Medium Agricultural Income								
Karnataka	4.2	.2	.6	5.3	.2	1.6	1.0	-4.7
Gujarat	6.5	-.2	-7.2	8.7	1.0	1.0	1.6	1.7
Low Agricultural Income								
Madhya Pradesh	8.2	1 2	.3	2.8	2.5	1.1	.5	-.1
Bihar	5.4	.5	-.2	2.7	.5	1.3	.6	-.1
B. Urban Areas								
High Agricultural Income								
Punjab	11.6	.1	3.4	4.9	.2	-.2	2.4	.8
Haryana	24.9	.3	4.1	18.5	4.9	.7	-1.9	-1.7
Medium-Agricultural Income								
Karnataka	6.0	0	-2.2	10.4	2.3	1.2	-5.9	.4
Gujarat	14.1	-.4	-.4	14.2	-1.7	2.5	5.3	-5.4
Low Agricultural Income								
Madhya Pradesh	.2	-.6	-1.9	6.3	4.4	3.2	.9	-12.1
Bihar	-14.6	-5.9	-4.9	3.1	-.1	-1.7	-2.4	-2.7

a/Karnataka was called Mysore prior to 1971.

b/Urban includes all localities over 5,000 in population. It encompasses both rural towns and large urban areas.

Source: India (1971a-b, 1981c). See Appendix Table A.9 for the raw data.

Table A.9: Employment Density by Activity in Six Indian States, 1971–81

		Non-Agriculture								
	Agriculture	Total	Mining	House-Hold Mftr.	Non-House-Hold Mftr.	Constr.	Comm.	Trans.	Other Services	Total
	(Full-Time Workers per 1,000 Population)									
a. Rural Areas										
Punjab										
1981	226	67	0	7	15	5	12	7	22	293
1971	231	60	0	10	9	4	9	4	23	291
Haryana										
1981	215	67	0	17	15	5	10	5	23	282
1971	208	57	1	9	9	4	8	3	24	265
Karnataka										
1981	335	61	2	14	13	4	11	3	13	395
1971 a/	307	57	1	13	8	4	9	2	18	364
Gujarat										
1981	279	53	1	2	17	3	10	5	15	332
1971	283	46	1	9	9	2	9	3	13	330
Madhya Pradesh										
1981	365	44	3	12	6	4	6	2	12	409
1971	348	36	1	12	3	2	5	1	12	384
Bihar										
1981	253	38	3	7	7	1	7	3	11	291
1971	281	33	2	7	4	1	5	2	11	313
b. Urban Areas b/										
Punjab										
1981	35	263	0	10	73	10	70	24	75	298
1971	30	251	0	7	68	10	70	22	74	281
Haryana										
1981	30	258	0	10	76	14	66	21	71	289
1971	30	233	0	6	58	9	65	23	73	263
Karnataka										
1981	52	247	3	18	70	15	57	25	60	299
1971 a/	55	241	3	20	60	12	55	31	60	296
Gujarat										
1981	29	258	1	8	95	9	57	28	59	288
1971	31	244	2	8	81	11	55	23	64	276
Madhya Pradesh										
1981	75	241	7	18	59	13	51	25	68	316
1971	40	241	7	20	53	9	48	24	80	281
Bihar										
1981	47	212	19	8	48	10	50	23	54	258
1971	57	226	25	13	45	10	52	25	56	283

a/ Karnataka was called Mysore until 1971.

b/ Urban includes all localities over 5,000 in population. It encompasses both rural towns and large urban areas.

Source: India (1971a-b, 1981c).

Table A.10: Variations in Male Agricultural Wages a/ Across Regions, India 1970/71-1984/85

State	1970/71	1974/75	1984/85
	(1970/71 Rs./day)		
High Agricultural Productivity			
Punjab	6.5	4.9	6.3
Haryana	6.3	4.4	6.3
Medium Agricultural Productivity			
Gujarat	2.9	1.9	4.2
Karnataka	2.5	1.8	2.4
Low Agricultural Productivity			
Madhya Pradesh	2.2	1.5	3.0
Bihar	2.6	2.1	3.7

a/ Simple average of all agricultural labor categories as published by Ministry of Agriculture's Agricultural Wages in India and reported by Acharya (1988). Deflated by agricultural labor price index (ALPI) using 1970/71 as the base year.

Source: Acharya (1988).

Table A.11: Composition of Change in Rural Income for a Panel of Households India 1970/71 - 1981/82

	1970/71 Household Income	Change in Income 1970/71 to 1981/82				Other/ Total
		Ag.	Wages	Other	Total	
		(Real Rupees a/ per Household)				
Land Owners	6,979	-106	106	905	959	94%
Marginal	4,468	369	94	961	1,425	67%
Small	6,757	-60	192	811	942	86%
Medium	10,639	-392	248	956	812	118%
Large	19,105	-3,947	87	1,255	-2,605	48%
Landless	4,309	885	101	614	1,601	38%
Ag. wage earners	3,580	627	-410	838	1,254	67%
Other	5,277	960	745	333	2,038	16%
Total	6,147	203	142	815	1,159	70%

a/ All income deflated to 1970/71 prices.

Source: NCAER (1986a).

Table A.12: Rural Consumption Profile by Expenditure Class, India 1983

	Monthly per Capita Expenditure Class in Rupees													
	0-30	30-40	40-50	50-60	60-70	70-85	85-100	100-125	125-150	150-200	200-250	250-300	Over 300	All Classes
Food														
Cereals	52.3	53.8	51.0	48.5	45.9	43.1	40.2	35.4	30.4	26.0	21.3	17.5	13.3	32.3
Gram	.6	.5	.4	.3	.3	.2	.2	.3	.3	.3	.2	.3	.3	.3
Cereal substitutes	1.1	.5	.4	.3	.3	.2	.2	.2	.2	.2	.2	.1	.1	.2
Pulses	2.9	3.3	3.9	3.9	4.0	3.9	3.8	3.8	3.6	3.4	3.1	2.8	2.5	3.5
Milk and milk products	.6	1.5	2.3	3.0	3.9	5.1	6.4	7.6	9.0	9.9	10.2	9.9	8.3	7.5
Edible oil	3.2	3.6	3.9	4.1	4.2	4.4	4.3	4.2	4.1	3.9	3.7	3.5	3.7	4.0
Meat, egg, fish	3.5	1.7	1.8	2.2	2.5	2.7	3.0	3.2	3.3	3.4	3.4	3.4	2.8	3.0
Vegetables	5.8	5.3	5.6	5.6	5.6	5.5	5.3	5.1	4.8	4.4	4.0	3.6	2.9	4.7
Fruits and nuts	.3	.6	.6	.7	.8	1.0	1.1	1.3	1.5	1.7	1.9	1.9	1.9	1.4
Sugar	1.2	1.7	2.1	2.3	2.5	2.6	2.7	2.9	3.1	3.0	2.9	2.8	3.0	2.8
Salt	.6	.4	.4	.3	.3	.2	.2	.2	.2	.1	.1	.1	.1	.2
Spices	3.2	3.3	3.2	3.1	2.9	2.8	2.6	2.5	2.3	2.1	1.9	1.8	1.4	2.4
Beverages	1.3	1.6	1.9	2.0	2.4	2.7	3.0	3.3	3.5	3.8	4.1	4.4	4.0	3.3
Total foods	76.4	77.8	77.4	76.1	75.4	74.3	72.8	69.9	66.1	62.2	56.9	52.0	44.2	65.6
Nonfoods														
Pan, tobacco, intox.	3.1	3.2	3.2	3.3	3.2	3.2	3.1	3.1	3.0	3.0	2.7	2.7	2.5	3.0
Fuel and light	13.6	11.3	10.3	9.7	9.2	8.7	7.9	7.5	6.9	6.1	5.5	4.9	3.8	7.1
Clothing	1.3	1.2	1.5	2.2	2.8	3.6	4.7	6.3	8.5	10.9	14.8	18.4	17.9	8.6
Footwear	.1	.1	.2	.3	.4	.5	.6	.8	1.1	1.3	1.5	1.8	1.8	1.0
Miscellaneous goods and services	5.5	6.4	7.2	8.1	8.7	9.4	10.2	11.0	13.2	14.5	15.9	16.3	17.0	12.5
Durables	.1	.1	.2	.3	.4	.4	.6	.8	1.2	2.0	2.7	3.8	12.0	2.3
Total Nonfoods	23.0	22.3	22.0	23.0	24.0	25.7	27.2	30.1	33.0	37.0	43.1	48.0	55.0	34.4
TOTAL EXPENDITURE	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: National Sample Survey 38th Round. Sarvekshana Vol.9,No.3 (April 1986).

Table A.13: Regression Coefficients for Estimating Income Multipliers District Data

	AGW	AR	AP	AY	R^2	Wage Multiplier a/	Income Multiplier e/
Rural Areas							
(1) OLS b/	-.324	.027	1.087 e-5	.0444	.89	.356	.292
	(7.8)	(10.9)	(1.9)	(8.2)			
(2) OLS-PH c/	-.0182	.014	2.70 e-6	.0213	.99	.306	.251
	(.9)	(3.5)	(.4)	(3.6)			
(3) 2SLS-PH d/	.0639	.0051	3.88 e-6	.018	.72	.302	.248
	(.4)	(.4)	(.3)	(.6)			
Rural Towns							
(1) OLS	.0059	-.0033	1.21 e-5	.0124	.46	.155	.254
	(.2)	(1.9)	(3.1)	(3.3)			
(2) OLS-PH	-.0414	-.0005	4.13 e-6	.0212	.09	.198	.325
	(1.4)	(.2)	(.7)	(4.1)			
(3) 2SLS-PH	-.0011	.0002	-7.60 e-6	.0240	.04	.237	.388
	(.02)	(.03)	(.9)	(1.4)			
Rural Areas Plus Rural Towns f/							
(1) OLS	-.318	.0238	2.30 e-5	.0568	.89	.510	.545
	(6.5)	(8.1)	(3.5)	(3.9)			
(2) OLS-PH	-.126	.020	6.01 e-5	.0485	.26	.504	.576
	(2.7)	(3.7)	(.7)	(5.7)			
(3) 2SLS-PH	-.173	.0258	-1.66 e-5	.0707	.01	.538	.635
	(1.1)	(2.0)	(1.2)	(2.4)			

Notes:

AGW = total agricultural wage earnings in each district (used as a proxy for total agricultural income)
AR = AGW*road density.
AP = AGW*population density.
AY = AGW*daily agricultural wage rate (used as an alternative to agricultural income per agricultural population)
Left side RNFY = Rural nonfarm wage earnings estimated as rural nonfarm labor*daily agricultural wage rate.
There were 83 observations.
The t-ratios are listed in parentheses under regression parameters.

a/ The wage multiplier is calculated as δRNFY/δAGW evaluated at the sample means of all relevant variables (given in Table A.10)

b/ Ordinary least squares estimate.

c/ Ordinary least squares with the Prais-Houthaker adjustment for heteroskedasticity.

d/ Two-stage least squares with the Prais-Houthaker adjustment for heteroskedasticity.

e/ In converting from wage to income multipliers, we make two adjustments. First, we multiply all wage multipliers by 0.82, the ratio of wage to total income in agriculture relative to nonfarm activity (Swa/Swn). Second, because rural town wage rates are double those in rural areas, we multiply the rural town wage multiplier by two. See note 13 for details.

f/ Multipliers calculated as sum of rural areas plus rural towns.

Table A.14: Data, Income and Wage Multipliers for Regions of Varying Agricultural Productivity[a/]

	Punjab/ Haryana	India Average	Karnataka/ Gujarat	Madhya Pradesh/ Bihar
Data				
Road density	8.3	6.1	4.3	3.2
Population density	3,338	2,775	1,645	1,853
Daily agricultural wage rate	8.1	5.5	5.4	3.9
Wage Multipliers				
Rural areas	.412	.302	.287	.227
Rural towns	.359	.237	.243	.169
Rural areas plus rural towns	.771	.538	.530	.396
Income Multipliers				
Rural areas	.337	.248	.235	.186
Rural towns	.589	.388	.399	.277
Rural areas plus rural towns	.926	.635	.634	.463

a/Estimated from 2SLS district regressions. See Table A.13 for regression parameters.

Table A.15: Regression Coefficients for Estimating Income Multipliers State Data

	AGY	AR	AP	AY	R^2	Income Multiplier
Rural Areas						
a/	.537.	0.0036	$-1.53_{e^{-6}}$	$-4.17_{e^{-6}}$	.81	.478
	(4.0)	(2.1)	(.04)	(1.6)		
b/	-.035	.0029	$3.2_{e^{-7}}$	$2.0_{e^{-6}}$	.73	.222
	(.7)	(4.2)	(.5)	(.2)		
Rural Towns						
a/	.286	.0003	$-1.12_{e^{-7}}$	$5.24_{e^{-5}}$	.67	.652
	(3.2)	(.2)	(.4)	(.3)		
Rural Areas Plus Rural Towns						
a/	.823	.0039	$-1.27_{e^{-7}}$	$3.65_{e^{-5}}$	.80	.794
	(4.1)	(1.5)	(.2)	(.9)		
b/	.321	.0003	$-1.95_{e^{-7}}$	$7.26_{e^{-6}}$	.84	.538
	(3.6)	(2.8)	(.7)	(.4)		

Notes:

AGY = total agricultural wage earnings in each state.
AR = AGY*road density.
AP = AGY*population density.
AY = AGY*daily agricultural wage rate (used as an alternative to agricultural income per agricultural population).
Left side = Rural nonfarm income.
All equations were estimated using ordinary least squares. Heteroskedasticity was not a problem in the state data, so no adjustment was necessary.
There were 17 observations.
The t-ratios are listed in parentheses underneath regression parameters.

a/ Nonfarm income estimated as nonfarm employment * average statewide nonfarm income per nonfarm worker.

b/ Rural nonfarm income estimated as employment * average agricultural income per farm laborer.

Table A.16: Regression Coefficients for Estimating Employment Multipliers

	AGW	AR	AP	AY	R^2	Employment Multiplier
District Data [a/]						
Rural Areas	.024 (3.3)	.0023 (3.7)	$-1.32e^{-6}$ (1.1)	-.0018 (2.5)	.02	.022
Rural Towns	.015 (2.9)	-.0002 (.6)	$6.65e^{-7}$ (.6)	-.0006 (.5)	-.02	.012
Rural Areas Plus Rural Towns	-.035 (3.7)	.0025 (3.3)	$-2.04e^{-6}$ (1.2)	-.0017 (1.7)	-.02	.037

	AGY	AR	AP	AY	R^2	Employment Multiplier [a/]
State Data [b/]						
Rural areas	$6.2e^{-5}$ (4.3)	$6.8e^{-7}$ (3.7)	$-2.4e^{-11}$ (.6)	$-1.2e^{-6}$ (.4)	.81	.021
Rural towns	$3.8e^{-5}$ (4.6)	$9.3e^{-6}$ (.9)	$2.5e^{-11}$ (1.0)	$-3.16e^{-6}$ (1.9)	.70	.016
Rural Areas Plus Rural Towns	$1.0e^{-4}$ (5.1)	$7.8e^{-7}$ (3.1)	$-4.9e^{-11}$ (.8)	$-1.4e^{-6}$ (3.7)	.82	.037

a/ AGW = total agricultural wage earnings in each district.
AR = AGW*road density.
AP = AGW*population density.
AY = AGW*daily agricultural wage rate (used as an alternative to agricultural income per agricultural population).
Left side = Rural nonfarm wage earnings estimated as rural nonfarm labor*daily agricultural wage rate.
All equations were estimated using ordinary least squares, with the Prais-Houthaker adjustment for heteroskedasticity.
There were 83 observations.

b/ AGY = total agricultural wage earnings in each state.
AR = AGY*road density.
AP = AGY*population density.
AY = AGY*daily agricultural wage rate (used as an alternative to agricultural income per agricultural population).
Left side = Rural nonfarm income.
All equations were estimated using ordinary least squares. Heteroskedasticity was not a problem in the state data, so no adjustment was necessary.
There were 17 observations.
The t-ratios are listed in parentheses underneath regression parameters.

Table A.17: Changes in Rural Consumption Patterns, India 1967/68 - 1983

Item	Average Budget Share, Rural Households			
	1967/68	1972/73	1977/78	1983
Foods				
Cereals	45.4	40.6	32.8	32.3
Grain	0.8	0.6	0.4	0.3
Cereal substitutes	0.8	0.5	0.3	0.2
Pulses	4.4	4.3	3.8	3.5
Milk and milk products	7.4	7.3	7.7	7.5
Edible oil	2.9	3.5	3.6	4.0
Meat, egg, fish	2.4	2.5	2.7	3.0
Vegetables	3.3	3.6	3.8	4.7
Fruits and nuts	0.9	1.1	1.1	1.4
Sugar	3.2	3.8	2.6	2.8
Salt and spices	2.7	2.8	3.0	2.5
Beverages	2.4	2.4	2.5	3.3
Total Foods	77.3	72.9	64.3	65.6
NonFoods				
Pan, tobacco, intoxicants	2.9	3.1	2.9	3.0
Fuel and light	5.6	5.6	6.0	7.0
Clothing	5.5	7.0	8.7	8.6
Footwear	0.5	0.5	0.7	1.0
Misc. goods and services	8.1	8.7	10.3	12.5
Durables	0.1	2.2	7.0	2.3
Total Nonfoods	22.7	27.1	35.7	34.4
Total Expenditure	100.0	100.0	100.0	100.0

Source: National Sample Survey, 38th Round as reported in Sarvekshana, Vol.9, No.3 (April 1986).

Table A.18: Rural Consumption Parameters Across States With Differing Agricultural Incomes, India 1983

State	Total Rural Expenditure	Budget Share Spent on Nonfoods	
		Average	Marginal[a/]
	(rupees/capita in 30 days)	(percent)	
High Agricultural Income			
Punjab	170.5	41.3	56.3
Haryana	151.8	36.4	46.3
Moderate Agricultural Income			
Karnataka	116.8	36.5	36.6
Gujarat	122.7	33.8	49.0
Low Agricultural Income			
Madhya Pradesh	100.5	33.5	45.5
Bihar	93.8	26.3	32.0
All India Rural Average	112.5	34.2	41.9

a/ Calculated as b1 + b2(1 + 1n(E)) where E = average total expenditure. b1 and b2 are obtained from Engel curves estimated in share form as follows:
Snf = bo 1/(E) + b1 + b2 1/ln(E) where Snf = Enf/E = share of expenditure on nonfoods. See Hazell and Roell (1983) for details on estimating procedure. Because household data were not available to us, we have used grouped data including 13 observations, one for each expenditure class reported by National Sample Survey.

Source: National Sample Survey, 38th Round as reported in Sarvekshana, Vol.9, No.3 (April 1986).

Table A.19: Semi-Input-Output Parameters for India, 1979/80

Input-Output Coefficients	Irrigated Agriculture	Rainfed Agriculture	Nontradable Agriculture	Manufacturing	Tertiary
Manufacturing[a/]	0.141	0.042	0.067	0.326	0.145
Tertiary	0.081	0.033	0.015	0.188	0.157
Nontradable agriculture	0.025.	0.[illegible]45	0.056		
Value added to gross output ratio	0.669	0.807	[illegible].761	0.300	0.640

Household Coefficients	Urban Households	Rural Households
Marginal Budget Shares		
Manufacturing	0.181	0.195
Tertiary	0.401	0.338
Nontradable agriculture	0.215	0.204
Leakage ratios	0.3	0.3
Value Added Shares		
Agriculture:		
- Irrigated	0.008	0.661
- Rainfed	0.005	0.802
- Nontradable	0.005	0.756
Manufacturing	0.108	0.192
Tertiary	0.230	0.410

Source: Input-output coefficients and value added shares adapted from 1979/80 input-output tables for India and Punjab reported in Bhalla et al. (1989). Consumption parameters based on Sarvekshana (1988) and Hazell and Ramasamy (1986). We took average budget shares from Sarvekshana and multiplied by expenditure elasticities from Hazell and Ramasamy.

a/ Does not include direct imports from abroad.

APPENDIX B:
A FIVE SECTOR SEMI-INPUT-OUTPUT MODEL

Consider an economy with five production sectors: agriculture divided into irrigated (I); rainfed (A); and nontradable agriculture (N); manufacturing (M); and tertiary activity (T). Nontradable agriculture includes many high-value livestock and horticultural products where perishability limits international trading. We also assume two household sectors: urban (U) and rural (R). Gross output in the irrigated and rainfed agricultural sectors is assumed to be constrained by technology, land or other inputs. Thus

$$I = \bar{I}$$

$$A = \bar{A}$$

But in the remaining sectors, output supply is assumed to be perfectly elastic. Hence gross output in these sectors is demand determined and depends on purchases required by households (H), producers (P), government (G), investment (J) and exports (E). That is,

$$N = H_n + P_n + \bar{G}_n + \bar{J}_n$$

$$M = H_m + P_m + \bar{G}_m + \bar{J}_m + \bar{E}_m$$

$$T = H_t + P_t + \bar{G}_t + \bar{J}_t$$

where subscripts refer to the sector to which demand is directed. Note that government expenditure, investment and manufacturing export demand are all exogenously determined in the model. Implicitly, manufacturing exports are assumed to be constrained by trade restrictions at home and abroad. In the absence of a balance of payments constraint, agricultural exports do not enter the model but, implicitly, are treated as a residual between an exogenously fixed output and an endogenously determined domestic demand. Similarly, we do not need to keep track of direct imports on manufactured goods from abroad.

Total income (Y), or value added, is allocated to households according to their value added shares (v_{ih}) in sectoral gross outputs, where the subscript i refers to the sector and h to the household class. That is,

$$Y_u = v_{lu}\bar{l} + v_{au}\bar{A} + v_{nu}N + v_{mu}M + v_{tu}T$$
$$Y_r = v_{lr}\bar{l} + v_{ar}\bar{A} + v_{nr}N + v_{mr}M + v_{tr}T$$

Household demand is taken to be a linear function of income less leakages (L):

$$H_i = H_{iu} + H_{ir},\ i = n,m,t$$
$$H_{ih} = \alpha_{ih} + \beta_{ih}(Y_h - L_h),\ i = n,m,t;\ h = u,r.$$

Leakages comprise savings plus taxes and, in total, are assumed to be directly proportional to income, that is,

$$L_h = s_h Y_h,\ h = u,r.$$

Producers demand intermediate inputs under Leontief fixed-proportions technology. Hence,

$$P_i = a_{il}\,l + a_{ia}\,A + a_{in}N + a_{im}\,M + a_{it}\,T,\quad i = n,m,t.$$

By substitution, total gross output in nontradable agriculture, manufacturing and tertiary activities can be rewritten as follows:

$$N = \alpha_{nu} + \beta_{nu}(1-s_u)Y_u + \alpha_{nr} + \beta_{nr}(1-s_r)Y_r + a_{nl}\bar{l} + a_{na}\bar{A} + a_{nn}N + a_{nm}M + a_{nt}T + \bar{G}_n + \bar{J}_n$$

$$M = \alpha_{mu} + \beta_{mu}(1-s_u)Y_u + \alpha_{mr} + \beta_{mr}(1-s_r)Y_r + a_{ml}\bar{l} + a_{ma}\bar{A} + a_{mn}N + a_{mm}M + a_{mt}T + \bar{G}_m + \bar{J}_m + \bar{E}_m$$

$$T = \alpha_{tu} + \beta_{tu}(1-s_u)Y_u + \alpha_{tr} + \beta_{tr}(1-s_r)Y_r + a_{tl}\bar{l} + a_{ta}\bar{A} + a_{tn}N + a_{tm}M + a_{tt}T + \bar{G}_t + \bar{J}_t$$

The equations for N, M, T, Y_u and Y_r can then be expressed in matrix form as:

$$
\begin{bmatrix}
1 - a_{nn} & - a_{nm} & - a_{nt} & - \beta_{nu}(1-a_u) & - \beta_{nr}(1-a_r) \\
- a_{mn} & 1 - a_{mm} & - a_{mt} & - \beta_{mu}(1-a_u) & - \beta_{mr}(1-a_r) \\
- a_{tn} & - a_{tm} & 1 - a_{tt} & - \beta_{tu}(1-a_u) & - \beta_{tr}(1-a_r) \\
- v_{nu} & - v_{mu} & - v_{tu} & 1 & 0 \\
- v_{nr} & - v_{mr} & - v_{tr} & 0 & 1
\end{bmatrix}
\begin{bmatrix} N \\ M \\ T \\ Y_u \\ Y_r \end{bmatrix}
=
\begin{bmatrix}
\alpha_{nu} + \alpha_{nr} + a_{nI}\,\bar{I} \\
\quad + a_{nu}\,\bar{A} + \bar{G}_n + \bar{J}_n \\
\alpha_{mu} + \alpha_{mr} + a_{mI}\,\bar{I} \\
\quad + a_{ma}\,\bar{A} + \bar{G}_m + \bar{J}_m + \bar{E}_m \\
\alpha_{tu} + \alpha_{tr} + a_{tI}\,\bar{I} \\
\quad + a_{ta}\,\bar{A} + \bar{G}_t + \bar{J}_t \\
v_{Iu}\,\bar{I} + v_{au}\,\bar{A} \\
v_{Ir}\,\bar{I} + v_{ar}\,\bar{A}
\end{bmatrix}
$$

Writing this system as

$$BX = D$$

then, after total differentiation, it becomes:

$$B\,dX = dD$$

where

$$dD = \begin{bmatrix} a_{nl}\,d\bar{l} + a_{na}\,d\bar{A} \\ a_{ml}\,d\bar{l} + a_{ma}\,d\bar{A} + d\bar{E}_m \\ a_{tl}\,d\bar{l} + a_{ta}\,d\bar{A} \\ v_{lu}\,d\bar{l} + v_{au}\,d\bar{A} \\ v_{lr}\,d\bar{l} + v_{ar}\,d\bar{A} \end{bmatrix}, \quad dX = \begin{bmatrix} dN \\ dM \\ dT \\ dY_u \\ d_{Yr} \end{bmatrix}$$

The solution to the model is then:

$$dX = B^{-1}\,dD$$

and this predicts the changes in N, M, T, Y_u and Y_r given an exogenous change in $\bar{l}$, $\bar{A}$ or $\bar{E}_m$.

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